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CONTENTS

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THE IONS OF THE ATMOSPHERE[1]

As one of the results of the recent development of electrical science it is considered that throughout the air in its normal state, and in other gases in a similar condition, there exists a small number of molecules, or groups of molecules, which are distinguished from the vast host of their fellows in being electrified. Each of these electrified entities, whatever its structure, is called an ion, and of ions there are two main classes, the one containing those which are positively, the other those which are negatively, electrified. The notion of the ion, in this connection, arises from attempts to reach a simple description of the facts associated with the conduction of electricity through gases, and the hypothesis admirably fulfils its purpose.

The number of ions in the air can be greatly increased by exposing it to the influence of Röntgen rays, or to the radiations from radium or other radio-active bodies, and it is from investigations connected with this artificially produced ionization that most of our present knowledge of ions is derived. For the most interesting account of these researches I refer you to the address delivered before this section at Dunedin in 1904 by the present distinguished president of the association. For my immediate purpose I have to remind you of one result: in an electric field, in addition to the motion of molecular agitation shared by all the constituents of a gas, the ions, in virtue of their charge, acquire a velocity whose average value depends on the electric intensity

[1] Presidential address before Section A of the Australasian Association for the Advancement of Science.

and on the resistance which is offered to the movement; under the influence of the electrical forces the ions drift, as it were, in a definite direction, the positives traveling to the negative electrode, and *vice versa,* a motion in which the uncharged molecules have no part. Other things being equal, it is assumed that this drift velocity of the ions is directly proportional to the electric intensity and following the suggestion of M. Langevin, the term "mobility" has been adopted for the average velocity acquired by an ion under the influence of unit electric force. At the present time the mobility of a class of ions is its most readily determined property, and it is principally to observations of the mobility of the ions in different gases and under various conditions that we must look for a clue to the nature of the ionic structure. In all cases I shall state the value of the mobility as that of the velocity, in centimeters per second, due to an electric force represented by a potential gradient of one volt per centimeter, that is, in practical units.

Two types of ion are recognized as existing naturally in the air, the small ion, with a mobility of about one and one half under normal conditions, and another, discovered by M. Langevin,[2] and called by him the large ion, which is characterized by the very small mobility of only $1/3000$. To these I now add a third, which has a mobility of about $1/100$ under normal circumstances. It may be called, for the present at least, the ion of intermediate mobility, or the intermediate ion.

M. Bloch[3] finds in air bubbled through water ions of mobility of the order of one or two tenths; these seem to form a fourth class of ions and it would be interesting to know if they exist in air not specially treated.

[2] Langevin, *C. R.*, t. 140, p. 232, 1905.

[3] Bloch, *C. R.*, t. 145, p. 54, 1907.

The small atmosphere ions are identical with those artificially produced in air by ionizing agents which have been made the subject of such numerous researches as described by Professor Bragg in his address. There is now considerable knowledge, resumed in the beautiful kinetic theory of gases, of molecular movements and dimensions, and when it is thought that an ion moves more slowly in an electric field than would a single molecule if charged, as the ion must be made of the stuff of the gas in which it is formed, what more natural than to consider it a cluster of a few molecules? This idea has been generally adopted. The small ions are thus assumed to be of somewhat greater size than their fellow molecules, but as the mobility notably increases with decrease of pressure, and with rise of temperature, their diameter is apparently not a constant quantity.

The direct argument, which is used to support this view, considers that in the numerous collisions which occur between the charged and uncharged molecules, in many cases the kinetic energy of the latter will not be great enough to carry them away, after impact, from the attraction of the charge. The charged molecule will thus collect other molecules around it, but as the effect of the charge on the outer members of the cluster diminishes as the collection of molecules increases, the growth will cease when the size is such that the attraction of the charge at the surface of the cluster, in grazing impact of ion and molecule, is just insufficient to hold the latter as a permanent member of the ionic system. The principle involved, in calculating the value of the limiting radius, is similar to that which determines whether a comet, in its close approach to the sun, shall become a permanent member of the solar system or wander into the space from which it came. The calcula-

tion of the ionic size which has been made on these lines assumes the ions as charged, the molecules as uncharged conducting spheres, and, taking the radius of the molecules as 10^{-8} centimeters, reaches the conclusion that the radius of the ion can not exceed three times this value.

To account for the change of mobility associated with alteration of the pressure or temperature conditions, it is supposed that the clusters of molecules forming the ions consist of fewer members at low pressures and at high temperatures than under ordinary circumstances. As the temperature rises, for instance, the ion may be imagined as shedding one by one its component molecules. The mobility, however, varies continuously and not by jumps; it may, therefore, be considered, in addition, that a cluster at any temperature does not always consist of the same number of molecules. In the numerous collisions, to which an ion as a constituent of a gas is subjected, a molecule of the cluster may be lost at one, to be gained at another impact, the cluster acting on the whole as if it contained the average number of members; it is this average number which, from this point of view, must be taken as decreasing continuously with rise of temperature.

From a consideration of the slow movement of the ions in an electric field compared with that which it is assumed a single charged molecule would have in the same circumstances, it is possible, with the aid of the principles of the kinetic theory, to make an estimate of the number of molecules which go to make an ion. The argument is given in Mr. Phillips's paper on "Ionic Velocities in Air at Different Temperatures,"[4] and he calculates from his results that the positive ion at $-179°$ C. consists, on the average, of about four and a half molecules (4.63), while at $+138°$ C. the average number is only about one and a half (1.52). For the negative ion slightly smaller figures are obtained.

Such an idea of the small ion, based, either on the direct argument in its restricted form already noted, or on the calculation just mentioned, can not be considered satisfactory, and it is now shown to be unnecessary by two workers at opposite sides of the world, Mr. Wellisch at Cambridge and Mr. William Sutherland at Melbourne.

In this connection it is interesting to recall another physical problem which apparently also required for its explanation a shrinkage of the molecules with rise of temperature, that of the relation between the temperature and the viscosity of a gas. The solution of the problem was finally reached in 1893 by Mr. Sutherland, from a consideration of the influence of molecular force in bringing about collisions which would otherwise not occur, the investigation being published in his paper on "The Viscosity of Gases and Molecular Force."[5] The result of mutual attraction, only sensible at small distances, is to make the molecules, considered forceless, behave as if they had a diameter greater than the true value. As the molecular force is less effective in causing collisions the greater the velocity with which two molecules approach each other, the apparent diameter to which it gives rise is less the higher the temperature. It is now shown by the writers I have mentioned that there is a similar effect due to the ionic charge. Owing to the influence of the electrical attraction, collisions between ions and molecules take place which would otherwise be avoided, and consequently the ions act as molecules of greater than the normal size, the apparent diameter decreasing as the temperature rises.

For the movement of an ion through

[4] Phillips, *Proc. R. S.*, A, 78, p. 167, 1906.

[5] Sutherland, *Phil. Mag.*, 36, p. 507, 1893.

a gas, M. Langevin[6] has given for the mobility, k, and the coefficient of diffusion, D, the equations,

$$k=\frac{eL}{MV};\quad D=\frac{LV}{3},$$

where e denotes the ionic charge, L the mean free path of the ion, M its mass and V its mean velocity of thermal agitation. Mr. Wellisch in his investigation calculates the mean free path of the ion, taking into account the effect of the ionic charge in increasing the collision frequency, and, substituting in the above equations, reaches general expressions for the two quantities under consideration. If the mass and dimensions of the ion are taken as the same as those of the molecule the expression for the mobility becomes at 0° C.

$$k=\frac{A\eta}{\rho_1 p}\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

and that for the coefficient of diffusion at the same temperature

$$D=\frac{\eta}{\rho}\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

where A ($=1.30\times10^{10}$ electrostatic units) is the product of the number of molecules per cubic centimeter and the ionic charge, η the coefficient of viscosity of the gas, K its specific inductive capacity, ρ the density and p the pressure in dynes per cm.^{2}, the symbols with subscripts referring to values under the standard conditions as to temperature and pressure.

To test the theory Mr. Wellisch gives the following table of comparison between the observed and the calculated values, the observed mobilities, except in the case of air, hydrogen, nitrogen and oxygen, being the results of a series of determinations recently made by him.

Gas or Vapor	Formula	Molecular Mass	$\rho_1\times10^6$	$\eta\times10^6$	$(K_1-1)\times10^6$	k_{760} Calculated	k_{760} Observed +	k_{760} Observed −
Air			129	177	59	1.25	1.36	1.87
Hydrogen	H_2	2	9	85	26	6.32	6.70	7.95
Carbon monoxide	CO	28	125	163	69	1.16	1.05	1.10
Nitrogen	N_2	28	125	163	59	1.31	1 6	mean
Oxygen	O_2	32	143	191	54	1.25	1.36	1.80
Carbon dioxide	CO_2	44	196	141	96	.87	.77	.81
Nitrous oxide	N_2O	44	196	141	107	.81	.79	.86
Ammonia	NH_3	17	76	96	770	.21	.70	.76
Ethyl alcohol	C_2H_6O	46	205	83	940	.19	.32	.26
Sulphur dioxide	SO_2	64	286	122	993	.13	.42	.39
Ethyl chloride	C_2H_5Cl	64.5	288	93	1,554	.11	.32	.30
Ethyl ether	$C_4H_{10}O$	74	330	69	742	.24	.28	.30
Carbon tetrachloride	CCl_4	153.8	686	153	426	.20	.29	.30

Mr. Wellisch further shows that if d denote the coefficient of interdiffusion of a molecule through the gas,

$$\frac{D}{d}=\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

and by the following table indicates the nature of the agreement between the calculated and observed values.

Gas	$\frac{(K_1-1)\pi A\eta^2}{2\rho_1 p_1^2}$	d Observed[7]	D Calculated	D Observed[8] +	D Observed[8] −
Air	3.70	.150	.032	.028	.043
H_2	5.39	.131	.205	.123	.190
O_2	3.56	.189	.041	.025	.040
CO_2	2.52	.109	.031	.023	.026

Both in the case of the mobility and in that of the coefficient of diffusion the agreement between the calculated and the observed values is, on the whole, quite satisfactory, the conclusion being that the behavior of the ion can be explained on the supposition that it consists of a single molecule associated with a charge equal to that carried by the monovalent ion in electrolysis.

Mr. Wellisch read an account of this investigation of the mobility and diffusion of the ions before the Cambridge Philosophical Society at its meeting held on

[6] Langevin, *Ann. de Chimie et de Physique*, V., 28, p. 289, 1903.

[7] See Jeans, "Dynamical Theory of Gases," p. 253.

[8] Townsend, *Phil. Trans.*, A, 193, p. 129, 1900.

November 9, 1908, and communicates a paper on the same subject to this section.

Mr. Sutherland, to our regret, is unable to be present at this meeting of the association, but he allows me to communicate to the section a letter of his on the theory of the small ion written to me on February 6, 1908, and permits me to mention the results of his investigation at this stage of our proceedings.

Amplifying the discussion developed in his viscosity paper by the addition, in the energy expression, of a term representing the electrical potential energy of ion and molecule when in contact, Mr. Sutherland, in his letter, proceeds to investigate the relation between the mobility and temperature and deduces for the mobility of the ion the simple expression,

$$k = \frac{A\theta^{\frac{1}{2}}}{+\frac{C'}{\theta - \theta'}}$$

where A is a constant, θ the absolute temperature, θ' the absolute boiling point, under the experimental pressure, of the substance of the gas in which the ions are formed, and C' a constant similar to that represented by C in his now well-known viscosity formula.

To test the theory Mr. Sutherland applies the equation to the experiments of Mr. Phillips[9] on the negative ion, taking $A = 0.1764$, $C' = 150.5$ and $\theta' = 70$, with the following results:

θ	411	399	383	373	348	333	285	209	94
k calculated	2.48	2.42	2.33	2.27	2.13	2.05	1.75	1.22	.235
k observed	2.49	2.40	2.30	2.21	2.125	2.00	1.78	1.23	.235

As will be noticed, the comparison of the mobility calculated from the above expression with the results of Mr. Phillips's valuable series of observations, shows an accordance well within the limits of experimental error, over the whole range of temperature from 95 degrees to 411 degrees absolute. The apparent decrease in the size of the ion with rise of temperature, as discovered by Mr. Phillips, is thus shown to be due to an effect of the ionic charge similar to that of molecular force which accounts for the apparent shrinkage of the molecules in the viscosity problem.

Mr. Sutherland shows, in addition, how his investigation enables an estimate to be made of the diameter of the ion, and concludes from his determination that most probably the small gaseous ion is the ordinary ion of electrolysis.

Mr. Sutherland's expression for the mobility of the ion, by containing a symbol representing the boiling point of the gas substance at the pressure of the experiment, indicates a dependence of the mobility on the pressure of the gas; the comparison of the values given by it have yet to be compared with the results of experiment.[10]

The idea of the small ion as a cluster of a few molecules, founded on insecure assumptions, was perhaps chiefly characterized by its numerical vagueness; its replacement by a definite theory can not but be regarded as marking a great advance in our knowledge of ionic structure.

Turning now to the consideration of the larger ions in the air, it may be said at once that our knowledge is as yet but represented by the mere collection of the results of experimental investigations. The large ions were discovered by M. Langevin[11] in 1905, who found that their movement, in an electric field with a potential gradient of one volt per centimeter, is only at the rate of one three-thousandth of a centimeter per second, but that, under natural conditions, their number is about fifty times as great as that of the small ions. In a later communication MM. Langevin

[9] Phillips, *loc. cit.*

[10] Langevin, *Ann. de Chimie et de Physique*, t. 28, p. 289, 1903.

[11] Langevin, *C. R.*, t. 140, p. 232, 1905.

and Moulin[12] describe an instrument for automatically registering the ionization of the atmosphere caused by the small and the large ions, with which they have experimented during the past few years; from the use of such an apparatus most important information will be derived.

For some time observations of these large ions, in the air at normal pressure, have been made at the physical laboratory of the University of Sydney. In this investigation I have been joined, at times, by students whose names will be given in connection with the mention of results they have obtained, and throughout have been most ably helped by my assistant, Mr. Carl Sharpe. Owing to the variable character of the natural ionization, the work has proved extremely tedious, as it is only on somewhat rare occasions that a series of observations is accordant enough to give a definite measure of the mobility. The ionization is more uniform after sunset and we observe mainly in the night time.

All our observations have been made with apparatus constructed after the pattern of that used with such success by Professor Zeleny,[13] in his determination of the mobility of the small ions. In such an instrument a uniform stream of air flows through a metal tube which forms the outer conductor of a cylindrical condenser, the ions drifting on to an inner axial electrode, due to the forces in the electric field established between the tube and the axial rod. The theory of the method of finding the mobility with such an apparatus, as given by Professor Zeleny, is well known; it has been followed without modification in calculating the results of the present series of experiments. Greater uniformity in the ionization is obtained if the air, before reaching the measuring tube, is drawn through a considerable length of piping. We have not noticed any effect on the nature of the ions due to the somewhat prolonged contact of the air with the metal of the pipes, and in most of our experiments several meters of iron or of galvanized iron piping have been employed. In all cases Dolezalek electrometers have been used to measure the ionization currents.

During the investigation some definite results have been obtained, of which I propose to give a general account.

In thinking of M. Langevin's discovery the idea must have occurred to many, and is indeed suggested by Professor Rutherford in his book on "Radio-active Transformations," that the large ions may be due to the presence of water vapor. My efforts to elucidate this point have resulted in finding that there is a definite relation between the mobility of the ion and the amount of moisture in the air.

When a current of air is passed over hygroscopic substances, without mechanical filtration, Mr. S. G. Lusby finds that large ions are absorbed and has noticed a loss in number amounting to 55 per cent., after the air had flowed over a tray containing phosphorus pentoxide. I find, in addition, that after leaving the drying agent, those large ions which still exist in the air decrease in mobility with time, and that when the relative humidity changes from 80 to 4 per cent., at a temperature of 19° C., they are not in equilibrium with the new vapor pressure conditions until after the lapse of about twelve minutes. Owing to the variable nature of the natural ionization, and perhaps to other causes, the calculated mobilities exhibit considerable irregularities, but show in an unmistakable manner, when the equilibrium state is established, a dependence of the mobility on the amount of water vapor in the air, the relation between the two

[12] Langevin and Moulin, *Le Radium*, 4, p. 218, June, 1907.

[13] Zeleny, *Phil. Trans.*, A, 195, p. 193, 1900.

quantities being apparently a linear one between the limits of the absolute humidity represented by 0.5 and 19.0 (grms./m^3), corresponding to relative humidities of 4 and 100 per cent. The mean mobilities for these values of the humidity, from results so far obtained, are 1/1280 and 1/3370, respectively. In other words the mobility for an absolute humidity of 2.4 is twice as great as that for a humidity of 15.4 (grms./m^3). The observations are not regular enough to show if there is any difference between the mobilities of the positive and negative ions. Owing to ionization being caused by phosphorus, it is not advisable to use phosphorus pentoxide as the drying agent in such experiments, and calcium chloride has been employed in all cases.

The intermediate ion has been under observation for only a comparatively short time. The measures so far made, however, show that the mobility is largely affected by change of the humidity of the air, the magnitude varying from one fifteenth to about one tenth of that number as the absolute humidity alters from 0.5 to 15 (grms./m^3) at a temperature of about 22° C. To this statement there is a limitation, the extent of which I do not as yet fully know—in air in its natural state with the absolute humidity between 14 and 16 grms./m^3, at 22° C. when the ionization due to this class of ions is relatively weak, the mobility, at least of the positive ions, is of the order of 1/65, while with strong ionization the value is only about half as great. Unless the limitation just mentioned provides an exception, on further investigation, no definite difference between the mobilities of the positive and negative ions of this class can be deduced from the observations.

The facts just described prove that there is a definite connection between the ions and the water vapor of the air, and open up an interesting field for speculation as to the development and structure of electrified clusters, and as to the nature of the resistance which they experience in drifting through the crowd of molecules. The basis of the structure is, of course, the molecular ion, which, it is well known, originates from effects associated with radio-active transformations occurring in the air, the ionization being primarily due to the presence of radium and thorium in the material of the earth's surface. The growth to more complex structure apparently occurs by the collection of water molecules round the molecular ion, owing to the influence of its charge.

Seemingly from a consideration of the experimental results, we must recognize at least two forms of electrified molecular aggregation in the air which are stable under ordinary conditions. As the mobilities depend on the humidity, it might not unreasonably be supposed that the intermediate and large ions represent stages in the development of the small ions into visible drops of water, which occurs if the air becomes sufficiently supersaturated. It seems, therefore, curious that the large ions are not separately apparent as condensation nuclei in cloud experiments.

Mr. C. T. R. Wilson[14] has shown that in such experiments the presence of a moderate electrical field prevents the formation of drops if the expansion ratio does not exceed the value 1.27. This proves that the nuclei for these small expansions are ions which can be removed by the field before the expansion takes place. I have carefully repeated the observations, with an apparatus similar to that described by Mr. Wilson, in order to determine if the effect of the electric field varies with the time it is on before expansion, and find the full effect whether the interval is one second or twenty minutes. With the fields

[14] Wilson, *Phil. Mag.*, June, 1904.

used it takes several minutes to remove all the large ions, on account of their small mobility, whereas the small ions disappear in less than a second, so the nuclei for the drops formed with expansions below 1.27 are small, not large ions. To test whether the large ions become visible at a lower humidity than that at which the small ones appear, Mr. E. P. Norman, at the Sydney University Laboratory, has repeated Mr. Wilson's experiments on the supersaturation required for condensation,[15] with natural air over mercury. Commencing with a humidity between 60 and 70 per cent., after removing the "dust," no condensation occurs, not only below saturation, but not until the supersaturation becomes four-fold, as in the earlier experiments over water. In all our experiments the observations have been repeated with air which has remained undisturbed in the apparatus overnight, in order that time might be available for the reproduction of the large ions if they had been initially withdrawn, but the results of the first expansion in the mornings appeared in no case different from those of the later ones. Now Mr. Lusby finds, using two Zeleny tubes in series, joined by earthed piping whose length can be varied, that if all the large ions are removed from a stream of air by the first tube, they are fully reproduced in number in about 22 minutes. Our failure to detect the large ions is not, therefore, because they were removed with the "dust," unless, indeed, large ions are not produced in closed vessels, a matter which it would be difficult to determine.

Considering that in natural air the large ions are fifty times more numerous than the small ones, it is hard to reconcile the fact that the separate existence of the former has never been suspected in condensation experiments with the idea of the large ion as representing a stage in the growth of the small one to a condition of visibility, and the experimental evidence as to the position of the large ion in this connection seems as yet in an unsatisfactory state.

MM. Langevin and Moulin[16] describe the small and the large ions as playing different parts in the formation of natural clouds, but the statement is merely one of suggestion.

As all the ions have the same charge, the electrical state of the atmosphere is conditioned by the numbers of the ions of each class which exist at the time. Should the numbers of positives and negatives be equal the air is electrically neutral, if, however, one kind greatly outnumbers the other the air is thereby highly electrified.

The number per cubic centimeter, or the specific number, as it may be called, of each class of ions in the air is an extremely variable quantity, particularly in the day time. From measurements in other parts of the world it is considered that the specific number of the small ions varies between 500 and several thousands. Between this estimate and that given by my own experience there is an amazing discrepancy. In a series of 128 observations, taken at Sydney in the early part of the year 1907, the maximum specific number is 157, the minimum zero, the mean number for the positives being 39 and that for the negatives 38. The European determinations are based on observations taken with Dr. Ebert's well-known ion counter, the principle of the apparatus being that of the Zeleny tube. With our present knowledge of the existence of the intermediate ions, it can readily be shown that the inner electrode of the instrument is altogether too long. The apparatus, as ordinarily employed, catches not only the small ions, but a proportion of the others as

[15] Wilson, *Phil. Trans.*, A, 189, p. 265, 1897.

[16] Langevin and Moulin, *loc. cit.*

well. Calculating with my own measures of the mobilities and specific numbers, it appears that the determination of the specific number of the small ions from the indications of the Ebert instrument must be from two to four times too great. As for the remaining part of the discrepancy, having used Dolezalek electrometers in my own observations, I may, perhaps, be prejudiced in thinking that the metal leaf electroscope of the Elbert apparatus is an unreliable appliance for use in such determinations; in any case the matter must be made the subject of a special enquiry, but in the meantime I have the utmost confidence in my own measures.

With regard to the other ions, from the very limited series of observations which I have as yet made of the intermediate ones, in air in its natural state, what I have previously called relatively strong ionization is represented by about one thousand per cubic centimeter, while for the relatively weak ionization the number is about two hundred.

For the specific number of the large ions, a series of 117 observations gives 5,500 as the maximum and 600 as the minimum, the mean for the positives being 1,914 and for the negatives, 2,228.

The numbers given, with the exception of those for the intermediate ion, are the results of measures with air drawn directly into the testing apparatus without the intervention of any pipes; later observations give much higher values for the specific number of the large ions in air led through a considerable length of piping.

It is now well known, since Lord Kelvin's memorable work on the subject, that a potential difference exists between the earth's surface and the upper layers of the atmosphere. In the electrical field, which is thus indicated, the ions in the air move more or less steadily in a vertical direction, the negatives ordinarily traveling upwards, the positives downwards to the earth. Such a movement constitutes a vertical electric current in the air, the magnitude at any time depending on the air's specific conductivity and the value of the potential gradient at the moment. The specific conductivity is represented by the sum of the continued product of the specific number, the mobility, and the charge for each class of ion. An instrument designed by Dr. Gerdien, in which an electroscope is used as in the Ebert apparatus, has been universally employed for such determinations as have been made of this important quantity. It measures the sum of the conductivities due to each type of ionization, and the calculation of the result from observations with the apparatus is not affected by the discovery of a new class of ions. The complexity of the natural ionization, however, prevents the instrument being used to accurately determine the specific number of the small ions. The average value of the specific conductivity of the air in other parts of the world, as given by the Gerdien apparatus, is about 10^{-4} in electrostatic units.[17] The magnitude of this quantity can be calculated from the measures of the mobilities and specific numbers of the ions, and the average specific conductivity of the air at Sydney, so determined, is only about one tenth of the value just stated. Here again there is a considerable discrepancy between my own and other measures which has yet to be investigated.

With increasing knowledge we can look forward to developments of importance to meteorology in connection with ionic observations; just now it is doubtful, I think, if valuable effort is not being wasted as a result of over-confidence in the present state of the art.

[17] Gerdien, *Gessell. Wiss. Gottingen, Nachr.*, Math-Phys. Klasse, 1, p. 77, 1907. Dike, *Terr. Magn. and Atmos. Elect.*, September, 1908.

Such is a sketch of our present knowledge of the ions of the atmosphere. With the publication of Mr. Wellisch's and Mr. Sutherland's investigations we have reached a definite idea of the small ion in air—a molecule, which, as the attraction of its charge brings about collisions which would otherwise not occur, acts as if it were one of more than the normal size—the conception enabling our experience to be not only simply but exactly described. Of the large ions, no such definite picture can as yet be drawn. Ions similar in character have been observed in gases from flames and in other cases, and it is to be hoped that the material which is now being collected may soon prove sufficient, in the hands of those specially skilled in the methods of the kinetic theory of gases, for a discussion of the life history of these molecular clusters. The study of the natural ions has a special interest, as a wider determination of the facts of the ionization of the air means an advance towards a more comprehensive knowledge of atmospheric electricity.

J. A. Pollock
University of Sidney

THE ELIZABETH THOMPSON SCIENCE FUND

The thirty-fourth meeting of the board of trustees was held at Harvard College Observatory, Cambridge, Mass., on April 29, 1909. The following officers were elected:

President—Edward C. Pickering.
Treasurer—Charles S. Rackemann.
Secretary—Charles S. Minot.

It was voted to close the records of the following grants, the work having been completed and publications made: No. 115 to H. S. Carhart, and No. 128 to L. J. Henderson; and to close upon receipt of publications the accounts of the following grants: No. 96, H. E. Crampton; No. 103, E. Anding; No. 112, W. J. Moenkhaus; No. 126, L. Cuénot; and No. 132, W. G. Cady.

Reports of progress were received from the following holders of grants:

No.		No.	
98.	J. Weinzirl.	137.	C. H. Eigenmann.
111.	R. Hürthle.	138.	Mme. P. Šafarik.
117.	E. Salkowski and C. Neuberg.	139.	J. Koenigsberger.
		140.	K. E. Guthe.
119.	J. P. McMurrich.	141.	J. T. Patterson.
123.	E. C. Jeffrey.	142.	W. J. Hale.
131.	F. W. Thyng.	143.	R. W. Wood.
133.	J. F. Shepard.	144.	G. A. Hulett.
135.	A. Negri.	145.	J. de Kowalski.
136.	H. A. Kip.	146.	M. Nussbaum.

The secretary stated that during the past year no reports had been received from the following holders of grants:

22, 27.	E. Hartwig.	121.	A. Debierne.
109.	A. Nicolas.	124.	P. Bachmetjew.

It was voted to make the following new grants:

No. 147. $200 to Professor Johannes Müller, Mecklenburg, Germany, to investigate the physiological chemistry of inosit.

No. 148. $200 to Professor C. C. Nutting, Iowa City, Iowa, for a report on the Gorgonacea of the Siboya Expedition.

No. 149. $200 to Professor Ph. A. Guye, Geneva, Switzerland, for determinations of atomic weights.

No. 150. $100 to Professor Charles A. Kofoid, Berkeley, Cal., for an investigation of the life history of the Dinoflagellates.

No. 151. $150 to Professor Otto v. Fürth, Wien, Austria, for a research concerning the relation of the internal secretion of the pancreas to the general metabolism and especially to the combustion of carbohydrates.

No. 152. $150 to W. D. Hoyt, Esq., Baltimore, Md., to study the fruiting of the marine alga, *Dictyota dichotoma*.

No. 153. $250 to W. Doberck, Esq., Sutton, England, for a position micrometer to be used in astronomical observations.

No. 154. $100 to Dr. J. P. Munson, Ellensburg, Washington, for an investigation of the minute structure of the chelonian brain.

Charles S. Minot,
Secretary

THE RETIREMENT OF PRESIDENT ELIOT

The faculty of arts and sciences of Harvard University has passed a minute on the services of President Eliot which reads as follows:

The faculty of arts and sciences records with gratitude its sense of the services which Charles William Eliot has rendered to Harvard University and to its own members. The changes he has wrought in the university will be remembered so long as the university endures. To this faculty he has been a guide and a friend no less than a leader. The qualities which mark him as great have nowhere appeared more clearly and spontaneously than in its meetings. He has shown judgment and resource, devotion to progress, love of truth, contempt for sham and indirection, and patience with those who differed or opposed. He has welcomed in catholic spirit every variety of intellectual ability, and has furthered the extension of every field of knowledge. He has been frank in the admission of evils, courageous and skilful in seeking for remedies; unfailingly attentive to every detail, always mindful of the large question of policy; cogent and effective in debate, generous toward the arguments of others. In the university and in this faculty, as in the outer world, he has stood for freedom of opinion and expression. He has been a leader not through official position but by force of character and intellect. His dealings with the teaching staff have been open, equitable and liberal to the extent of every available resource. His close contact with the members of the faculty has deepened in their hearts, with every added year of his long term, confidence, admiration and warm regard; and they now part from him with reluctance, but with thankfulness for what has been achieved by him and under him, and with faith that his work will be maintained.

THE WINNIPEG MEETING OF THE BRITISH ASSOCIATION

THE local secretaries for the meeting of the British Association for the Advancement of Science beg to remind intending visitors from the United States that members of the American Association for the Advancement of Science will be admitted as full members of the British Association for the Winnipeg meeting (and entitled to receive the volume of proceedings), on payment of a fee of $5. The meeting will be held from the twenty-fifth of August to the first of September, inclusive, and it is anticipated that a large number of visitors from the United States, as well as from Canada and Europe, will attend. It is important that those intending to be present should send in their names to the local secretaries, University of Manitoba, Winnipeg, as soon as possible; printed matter bearing on the meeting will gladly be furnished, as well as postcard forms giving various details of use to the local committee. The secretaries are in communication with the various passenger associations in connection with reduced fares via the United States, but for the present no definite statement can be given, except that the special fares in force in connection with the exposition at Seattle may be taken advantage of. A concession of single fare for the return journey has been secured on all Canadian railways, and those entering Canada should be able to obtain from the agent at the port of entry the standard convention certificate enabling them to secure this privilege. Circulars of information upon this and other matters will be forwarded upon application to the local secretaries.

SCIENTIFIC NOTES AND NEWS

DR. IRA REMSEN, president of the Johns Hopkins University, has been elected president of the Society for Chemical Industry for the meeting to be held next year in Glasgow.

MR. LAZARUS FLETCHER, F.R.S., the keeper of the department of mineralogy since 1880, has been appointed to the post of director of the natural history departments of the British Museum, vacant since the retirement of Dr. E. Ray Lankester.

AMONG the honorary degrees awarded by Columbia University at its recent commencement was that of master of science on Mr. B. B. Lawrence, the mining engineer; a doctorate of science on Dr. S. F. Emmons, of the U. S. Geological Survey; a doctorate of letters on Dr. Mary Whiton Calkins, professor of philosophy and psychology at Wellesley College, and a doctorate of laws on Dr. A. Lawrence Lowell, president of Harvard University.

NEW YORK UNIVERSITY has conferred its doctorate of laws on Dr. Borden P. Bowne, professor of philosophy in Boston University.

DR. S. O. MAST, associate in biology at the Woman's College of Baltimore, has received

the Cartwright prize of $500 for his work on "The Effect of Light on the Movements of Lower Organisms," awarded by the College of Physicians and Surgeons, Columbia University.

THE Linnean Society has presented its gold medal to Dr. F. O. Bower, F.R.S., regius professor of botany in the University of Glasgow.

PROFESSOR W. F. OSGOOD, of Harvard University, has been elected corresponding member of the Mathematical Society of Charkow.

M. E. BOUDIER has been elected a corresponding member in the Paris Academy of Sciences in the section of botany.

DR. GEORGES DREYER, professor of pathology in the University of Oxford, has been elected a member of the Danish Royal Academy of Letters and Science.

DR. W. W. DANIEL, professor of chemistry at the University of Wisconsin, has retired from the chair which he has held since 1868. His former students have presented the university with a portrait by Mr. J. C. Johansen, of New York.

THE trustees of Columbia University have awarded the Ernest Kempton Adams research fellowship, for the year 1909–10, to Professor C. W. Chamberlain, of Vassar College.

AT a meeting of the board of directors of the Rockefeller Institute for Medical Research, held on May 29, the following promotions and appointments were made: Associate, Paul A. Lewis (pathology); Assistant, F. Peyton Rous (pathology); Scholar, Angelia M. Courtney (chemistry).

DR. C. D. PERRINE, of the Lick Observatory, has proceeded to Buenos Ayres to assume the directorship of the Argentine National Observatory at Cordobe, vacant by the death of Dr. Thome. His address will be Observatorio Nacional, Cordoba, Argentina.

THE secretary of the Smithsonian Institution and Mrs. Charles D. Walcott sailed on June 5 to attend the commemoration of the centenary of the birth of Charles Darwin as the representative of the institution. During his stay in Great Britain, Dr. Walcott will visit the northwest coast of Scotland to collect and study specimens of Cambrian fossils found in that locality. He will return to Washington on July 3, after which he will proceed to British Columbia to continue there his field work.

PROFESSOR L. H. BAILEY, director of the College of Agriculture, Cornell University, has leave of absence for next year. Professor Herbert J. Webber will act as director.

DR. A. M. TOZZER, of Harvard University, has been given leave of absence for 1909–10 to carry on archeological investigations in Guatemala.

DR. NETTIE M. STEVENS, associate in experimental morphology at Bryn Mawr College, who has been studying at the Zoological Station in Naples and the University of Würtzburg as the Alice Freeman Palmer research fellow for the year 1908–9, will resume her work at the college next year.

DR. PAUL C. FREER, director of the Bureau of Science, Manila, has left, in April, for Europe by the Trans-Siberian route. Dr. Freer will spend some time studying the laboratory methods of the leading scientific institutions of Europe. He will return to the Orient after two months in this country.

DR. CHARLES L. EDWARDS, professor of natural history at Trinity College, will spend next year in Europe.

DR. F. O. GROVER, professor of botany at Oberlin College, will spend next year abroad.

LIEUTENANT SHACKLETON is expected to reach England about the middle of June. Several members of the *Nimrod* expedition have reached England, including Mr. Raymond E. Priestley, of Bristol, the geologist; Mr. G. E. Marston, of London, the artist; Mr. Ernest Joyce, London, who was in charge of the supporting party; Mr. Frank Wild, of Bedfordshire, who accompanied Lieutenant Shackleton furthest south, and Mr. Bernard Day, of Leicester, who had charge of the motor car.

DR. HENRY P. WALCOTT, chairman of the Massachusetts State Board of Health, will preside at the International Congress of Hygiene and Demography, which it is proposed to hold in Washington next year.

DR. W. H. HOWELL, dean of the Johns Hopkins Medical School, will give the anniversary

address at the Yale Medical School, his subject being "The Medical School as Part of the University."

DR. CHARLES S. MINOT, of the Harvard Medical School, delivered on May 27, at St. Louis, the commencement address in medicine for Washington University. The address was entitled "On Certain Ideals of Medical Education," and will be published shortly.

DR. DICKINSON S. MILLER, professor of philosophy at Columbia University, will give the Phi Beta Kappa address at Hobart College.

PROFESSOR I. WOODBRIDGE RILEY, of Vassar College, delivered the annual address before the American Medico-Psychological Association at Atlantic City on June 2. The subject was "Mental Healings in America."

The Electrical World states that an unfortunate complication has arisen concerning the location of the memorial statue to Lord Kelvin in his native city of Belfast. It has been decided to erect the statue in the grounds of the Queen's College, but it was subsequently pointed out that such use of the grounds would be legally a breach of trust under the terms of tenure of the property. In the meantime, some of the subscribers to the memorial have served formal notice restraining the Lord Mayor from expending any of the money subscribed until the questions regarding the site have been satisfactorily determined.

DR. WILHELM ENGELMANN, professor of physiology at Berlin, has died at the age of sixty-five years.

DR. GEORGE VON NEUMAYER, the eminent meteorologist, has died at Neustadt at the age of eighty-three years.

TABLES at the laboratory of the United States Bureau of Fisheries, at Beaufort, North Carolina, will be available for the use of investigators after July 1. Requests for further information should be addressed either to the commissioner of fisheries, Washington, D. C., or to the director of the laboratory, Beaufort, N. C.

THE third annual geographical conference was held, on the invitation of Professor Davis, in the Geographical Laboratory of Harvard University on Saturday, May 29, and was attended by over forty teachers from the schools of Boston and neighboring cities. Recent proposals regarding the teaching of geography in secondary schools were discussed, and an excursion to the coastal plain of Maine was planned for June 26.

AT the last meeting of the International Physiological Congress, which was held at Heidelberg, in 1907, it was decided to hold the next Congress at Vienna in 1910, at Whitsuntide. The *British Medical Journal* states that it has been found that at this time of the year it would be impossible for a large number of physiologists to attend the congress, and the local committee of the congress at Vienna has therefore, after consulting the local secretaries in the various countries, determined to change the date of the congress. In accordance with the general wish, it will be held from September 26 to 30, 1910.

IT has been arranged to transfer the whole of the Vatican Observatory to the summit of the Vatican Hill, 100 meters above the square of St. Peter's, where a section of the observatory has been for some years.

FOREIGN papers state that the central committee of the Austrian Alpine Club has by the authorities of Munich been put in possession of a large building with excellent accommodation and well situated on the banks of the Isar. The club proposes to inaugurate an Alpine museum in its new building.

THE Pacific coast will soon be the scene of an interesting tree-growing experiment. The United States Forest Service is planning to introduce a number of the more important eastern hardwoods into California, and will this year experiment with chestnut, hickory, basswood, red oak and yellow poplar or tulip trees. Small patches of these trees will be planted near the forest rangers' cabins on the national forests, and if these do well larger plantations on a commercial scale will soon be established on wider areas. There are over 125 different species of trees in California, a number of which produce some of the most valuable varieties of lumber in the country. Although considerably over one half of the species are hardwood or broad-leaved trees, yet, with the exception of the exotic eucalyptus,

there is not a single species of hardwood here ranking in commercial importance with the leading eastern hardwoods. Climatic conditions in many parts of California are favorable for the growth of a number of the valuable hardwoods, and the absence of these trees is due mostly to unfavorable factors of seed distribution.

UNIVERSITY AND EDUCATIONAL NEWS

The General Education Board has offered to give the Johns Hopkins University $200,000 on condition that a million dollars be raised for the removal of the university to its new site at Homewood.

Mr. N. W. Harris has promised to give Northwestern University $155,000 if the college will procure the remainder of a million dollars during the coming year.

The New York *Evening Post* states that Mrs. D. G. Richardson, who in the past has contributed liberally to the medical school of Tulane University, has recently given property valued at $55,000, and yielding an income of $3,000 for the endowment of the chair of botany. Professor R. S. Cocks fills the newly created chair.

The debt of Columbia University contracted in part payment of its new site and buildings has been funded, and the United States Trust Company has taken a mortgage of $3,000,000 on the blocks owned by the university on Fifth Avenue between forty-ninth and fifty-first streets. The university will pay off this debt in thirty annual installments.

Professor Irving Hardesty, the head of the department of anatomy at the University of California, has been appointed to the head of the department of anatomy in Tulane University, Louisiana.

Dr. George H. Ling, adjunct professor of mathematics at Columbia, has accepted the professorship of mathematics in the newly-established University of Saskatchewan.

Dr. Frank G. Speck, instructor in anthropology, has accepted the position of assistant professor of anthropology in the University of California.

Walter K. Van Haagen, assistant in chemistry at Lehigh University, has been elected associate professor of chemistry at the University of Georgia.

Professor J. A. Brown has resigned his position at Dartmouth College to accept the chair of physics at the Protestant College of Beirut, Syria.

Mr. Charles B. Gates, assistant in chemistry at the University of Wisconsin, has been chosen instructor in chemistry at the Michigan College of Mines.

Professor G. Elliot Smith, F.R.S., of the Government School of Medicine, Cairo, has been appointed to the chair of anatomy in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

ON THE TEACHING OF THE ELEMENTS OF EMBRYOLOGY

In 1893 Professor A. Milnes Marshall wrote in the preface to his "Vertebrate Embryology":

> Great attention has of recent years been given to the study of embryology, and yet it is curiously difficult to find straightforward accounts of the development even of the commonest animals. . . . In works professing to deal with human embryology it is more common than not to find that the descriptions, and the figures given in illustration of them, are really taken, not from human embryos at all, but from rabbits, pigs, chickens or even dogfish.
>
> This latter practise is a most unfortunate one, and has been the cause of much confusion. The student is led to suppose that our knowledge is more complete than is really the case, while at the same time he finds the greatest difficulty in obtaining definite information on any particular point in which he is interested.

This very temperate statement needs to be repeated to-day with greater emphasis, for the attention given to the study of embryology has increased with the years; it is required from practically every student of medicine and of biology, and it is as difficult as ever, if not more so (for old accounts grow out of date), to find straightforward accounts of the development even of the commonest animals. Now, as then, our text-books leap from fish to man, back to *Amphioxus,* and forward again, with stops at intermediate stations, amphibians, reptiles and birds, in such a way as to

confuse the student seriously. His confusion is increased if he compares different books, for they are apt to select different illustrations from the unlimited body of facts; and statements are often contradictory. Moreover, it is frequently impossible to say when the description passes from one form to another, or indeed, what species of animal, or pale phantom of the imagination, is in the author's mind at all.

The distinction between fact and theory is a useful one, even in embryology; indeed, I know of no distinction so important for the student to master. But in the text-books of embryology there is a nebulous zone between peopled with morulæ, blastulæ, gastrulæ, germ-layers, etc., which dissolve and reappear in strange forms never the same. And the student is often uncertain whether he is on the sure ground of fact, in the fascinating field of theory or in the twilight zone between. Such uncertainty is demoralizing, because it limits his respect for exact facts and does not increase his capacity for sound generalization. The student who gains his conception of a developmental sequence by combining the morula of a mammal, the blastula of a starfish, the gastrula of *Amphioxus* and the germ-layers of a frog is as far removed from connected facts as from sound theory.

Such method of the text-book is of course ill-adapted to laboratory practise and there is usually a gap between. The student's laboratory practise is usually limited to an anatomical study of a few stages of one or a few forms, and if he turns to the text-book to bind his observations into a sequence, he finds brief superficial descriptions of disconnected stages of a great variety of forms, for the most part, of course, different from those he is studying in the laboratory. Neither in his laboratory practise nor in his text-book does the student obtain genuine understanding of the development of any single form. It would be just as reasonable to expect proper comprehension of the principles of comparative anatomy of vertebrates without knowledge of the anatomy of any definite species as to expect real understanding of the principles of comparative embryology from a student who does not know a single life history thoroughly.

These conditions are seriously aggravated by secondary considerations of the text-books, such as the alleged greater significance of certain aspects of the life history for various practical disciplines, which leads to unjust emphasis, and to the view that embryology is a field from which only facts of practical value are to be culled; I am far from denying the significance of the study of embryology for medicine, for instance, but I would maintain that much of its significance is lost by piecemeal selections. If the facts and principles are understood, the applications may be readily made at the proper time and place, but if they are not understood the applications are surely of doubtful value.

Theory changes so rapidly in embryology that text-books soon grow out of date; and tastes differ so widely that the selection of facts for a book fails to satisfy more than a limited number of teachers. Hence the constant procession of text-books of embryology. In this state of affairs there is bound to be a reaction, and it appears to me that this must take the form of a series of text-books dealing with the concrete development of single forms.

Probably no text-book of embryology has been so influential and of so long continued service as Foster and Balfour's "Elements of Embryology," of which the first edition was put forth in 1873, and the second edition (enlarged) in 1883, soon after Balfour's untimely death. Even now, although it has not been revised for twenty-six years, it is still in active service. The reason for this lies partly in the simplicity and clearness of the style, but largely in the fact that the greater part is a literal account of the development of a single form, the chick; it takes up the events of the development of each day, to the end of the sixth day at least, "as though the development were done by day labor," which is indeed the case, and the student obtains some idea of time-relations which are of the essence of embryonic development; he is made to see development as a continuous process marching steadily forward to a definite consummation;

and he controls the statements of the book by his observations in the laboratory; and where the latter are incomplete they can be supplemented by reference to the former.

The continued usefulness of this little book is an object lesson in embryological pedagogy by which the writer tried to profit in writing a new "Development of the Chick" which should bring the subject matter up to date, and serve as an introduction to embryology. On the whole it seems improbable that the chick will be displaced as the favorite subject for laboratory practise in embryology, because the material is of universal occurrence and available at all seasons of the year without great expense. Moreover, the technique is as simple as that of any other form, at least after the egg is laid; and the knowledge of its development, while yet incomplete, is certainly more considerable than that of any other animal with the possible exception of man himself.

Professor Metcalf's objections to the use of the chick for introducing students to the subject of embryology[1] do not appear to me to be well grounded. He complains that the embryo chick is "highly specialized" and "distorted from the general vertebrate type," and that "the space relations of the organs are distorted by secondary influences." For these reasons he prefers the frog, and wishes that there were an embryology of this form. I echo this wish and hope that Professor Metcalf will undertake to write one. I am afraid, however, that the inconsiderate agriculturalists who domesticated the hen and taught her to lay the year around have conferred on her an unfair advantage; and it appears to me better for the elementary student to study living hens' eggs than preserved frogs' eggs. This is indeed the main advantage that I see on the side of the chick. But I believe that the objections on account of "specialization" and "distortion" are more deeply rooted in tradition than in nature.

But whether the student uses the frog or the chick, or some other form, he needs a fairly complete and modern book of reference of the same form, if not to replace, at least to supplement, the comparative text-books. In this contention I think Professor Metcalf will agree. We need above all objectivity in the teaching of embryology; we must require some basis of exact facts to support generalizations, and keep the distinction between the two clear in the student's mind.

Frank R. Lillie

University of Chicago

[1] Science, N. S., XXIX., May 7, 1909, pp. 738–739.

GENERA WITHOUT SPECIES

In Science for February 26, 1909 (pp. 339, 340), Professor Cockerell discussed the "controversy" concerning "genera without species," pointing out the difficulty of dealing with such cases, since they are not distinctly provided for in the International Code of Zoological Nomenclature. Apparently each case should be dealt with solely on its merits. A few illustrations may help to make this point clear. In 1799 Lacépède proposed the genus *Picoides,* giving a short diagnosis of it, but omitting to refer to it any species. The diagnosis clearly indicates a woodpecker having only three toes. The only species of woodpecker at that time known with only three toes was the three-toed woodpecker of northern Europe, *Picus tridactylus* Linn. This species being clearly the basis of the diagnosis, it may be taken as the type of the genus *Picoides,* now, for a long time, current for the group containing this and other closely allied species.

In the same way, and at the same date, Lacépède proposed the name *Astur* for a genus of short-winged, long-legged hawks, giving for the genus a wholly inadequate diagnosis, without mentioning under it any species. In 1806 Froriep published a German translation ("Analytische Zoologie") of Duméril's "Zoologie analytique," adding to it, *passim,* much new matter, including the mention of examples under Duméril's genera, which, for the most part, were originally proposed by earlier authors, without, of course, the designation of types. As an example of *Astur* Froriep gave the species *Falco palumbarius* Linn., which thus may be taken as the type of *Astur.* But the genus should date

from Lacépède, 1799, and the type from Froriep, 1806. The genus has been current for more than a century, during which period the same species has been repeatedly and independently designated as its type by various subsequent authors.

Forster in 1788 published a work (" Enchrid. Hist. Nat.") in which he gave diagnoses of the genera of birds (and other animals) then known to him, but without referring to them any species. Some of them were for the first time characterized and named, among them the genus *Gavia*. His diagnosis, with the context, shows unequivocally that *Gavia* was proposed for the loons, a group comprising, as now known, some half-dozen species, all strictly congeneric, and so different from all other birds as to constitute a distinct superfamily. *Gavia* was, furthermore, the first generic name proposed for the group. It only remained for some one later to select some one of the loon species as its type.

Muscivora was proposed by Lacépède in 1799, for a genus of tyrant flycatchers, but he referred to it no species. It was not satisfactorily determinable till a species was referred to it by G. Fischer in 1813.

Cuvier in 1800 published (" Leç. d'Anat. comp.," tab. ii.) a considerable number of genera now currently accepted from this source, without giving either diagnoses or other basis for them beyond citing their equivalent vernacular French names, which names are, however, identifiable from a slightly earlier work (" Tabl. élém. de l'Hist. nat.," 1798) of the same author where these vernacular names are coupled with their proper technical designations. In a few cases his generic names are not thus identifiable, and are hence to be ignored.

These examples, selected from many that are available,[1] seem to show clearly that " genera without species " should be dealt with according to their individual merits. They seem also to fully answer Professor Cockerell's question, " Who can define a genus except as including species ? "

[1] For example, Lacépède, in his " Tableau . . . des Oiseaux " (1799), recognized 130 genera of birds, of which 19 were here first proposed, all solely on the basis of diagnoses; of these 11, or more than one half, are now, and always have been, in universal use; the others were homonyms or preoccupied names.

It may be noted further that while this question is not considered in the International Code, it is fully discussed and provided for in the A. O. U. Code, where a diagnosis is recognized as a valid basis for a generic name, with the provision, however, that " a name resting solely on an inadequate diagnosis is to be rejected, on the ground that it is indeterminable and therefore not properly defined." This ruling is based on general usage for nearly a century, as well as on common sense; to reject it would result in the overthrow of many generic names that have been current in vertebrate zoology for almost a century. It may be added that while the A. O. U. Code of Nomenclature and the International Code of Nomenclature are in perfect accord in respect to principles and spirit, the A. O. U. Code is much fuller and more explicit than the International, taking up in detail a large number of questions not included in the latter. This may well be the case, inasmuch as the A. O. U. Code is a document of some fifty pages while the International Code is comprised in a dozen pages.

Postscript.—Since the above was sent to SCIENCE, Professor Cockerell has returned to the subject of " Genera without Species,"[2] giving abstracts of replies received by him from a number of correspondents in response to a suggestion to that effect made in his former communication.[3] These replies are not only interesting, but possess some importance as showing the opinions on this question of a number of entomologists and botanists. The twelve gentlemen here represented seem to pretty unanimously agree with Professor Cockerell that (to quote from one of them) " generic names published without any mention of included species are to be regarded as invalid "; or, as otherwise stated, " are nomina nuda." This remarkable unanimity seems to me to be due either to limited experience in this difficult field, or to a lack of knowledge of

[2] SCIENCE, May 21, 1909, pp. 813, 814.

[3] SCIENCE, February 26, 1909, p. 340.

the history of nomenclature; in other words, as off-hand opinions as to what seemingly ought to be, regardless of the actualities of the case.

Nomenclature (both zoological and botanical) has attained its present stage of comparative orderliness by slow stages of development. For the first seventy years of its history such a concept as a "genotype" appears to have been rarely, if ever, thought of; and it was not until the first quarter of the nineteenth century had passed that types of genera began to be considered as a necessary part of the proper basis of a genus. Prior to 1810 hundreds of genera now in current use were proposed solely on the basis of a diagnosis; although they were accepted and have been in use from the date of their proposal, many of them were without designated types for half a century. Yet the authors of this early period were in substantial agreement as to what groups of species these generic names were intended to include. From the modern viewpoint these genera were (usually) heterogeneous groups, each comprising several modern genera. In the process of division a type was sooner or later, by restriction or by actual designation, assigned to the original genus. Not till then did the genus, from the modern viewpoint, become properly established. Many other genera of this early period, similarly proposed, are unidentifiable. I can not agree that these two categories should have the same treatment. Nor can I agree that a long-accepted genus must date from the author who, long after it was originally founded, "validated" it by designating a type for it; but rather, as indicated in the first part of this communication, that the genus should date from its founder. Otherwise nearly all of the early genera for birds would date from about 1840, after many of them had been in general use for one half to three fourths of a century. In the case of mammals, many of the early genera were not thus "validated" till many years later than those of birds. To take genera from the date of "validation" would obviously establish a new source of trouble in relation to priority of names.

It is now the custom of a large number of nomenclators to make a distinction between a nomen nudum and a name that is for any reason unidentifiable;[4] the former can be employed by a later author, from whom it must date; the latter can not be again used, the attempt at a diagnosis, however brief or inadequate, precluding its subsequent employment. Hence a name founded on a diagnosis, and subsequently validated, can not be taken from the validating author, but must date from the founder, if this rule be followed. Furthermore, to call a genus a nomen nudum when based on a diagnosis is a misuse of language, and entirely contrary to usage.

J. A. ALLEN

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THE ORIGIN OF THE MOON

IN his inaugural lecture delivered in Columbia University, November 3, 1908,[1] Dr. Albrecht F. K. Penck, the Kaiser Wilhelm "Umtausch" Professor, spoke in part as follows concerning the geographical and geological similarities between the eastern coast of North America and the western coast of Europe:

> These similarities between Europe and peninsular North America are not merely superficial ones. *In a very remarkable way, these two sides of the Atlantic repeat the same structural features;* there is an astonishing symmetry, as Eduard Suess has shown so clearly. The northeast of Canada and Labrador on one side, and Scandinavia with Finland, the region of Feno-Scandia, on the other, are both composed of the oldest rocks we know of. These have a very complicated structure, being intruded with many eruptive rocks, and in a secondary way only, the surface features of the above regions are dependent on their structure. Both regions had already been leveled down before Cambrian times, and they sink gently down under a cover of horizontal Paleozoic strata. Both were called by Suess shields. The resemblance between these shields is the more conspicuous because both were covered during the last ice age by a glaciation which molded their surface in a similar way. In Sweden and Finland we find the same rounded

[4] See Revised A. O. U. Code, Canon XXXIV., and the explanatory "remarks."

[1] For the whole lecture see SCIENCE, February 26, 1909.

glaciated surface, the same numerous lakes, as in Canada, both regions of the earth claiming to be the land of the many thousand lakes. At the border of both regions the horizontal Paleozoic strata begin with an escarpment which is pronouncedly developed south of Lake Erie and south of the Gulf of Finland, called here the "glint," and we shall keep this expression to designate similar escarpments. These strata continue far into the interior of Eurasia, and they do the same in North America.

And again:

It is very interesting to see how the Appalachian region ends at Newfoundland, forming the projecting eastern corner of North America, and just opposite in south Ireland, in south Wales, in Cornwall and in Brittany the belt of the old Hercynian Mountains of Europe begins. One seems to be the continuation of the other, and such an excellent geologist as Marcel Bertrand maintained that *we have here to deal with the two ends of one very extensive belt of mountains which extended through the North Atlantic Ocean. But we must not forget that the missing link between both ends of these supposed mountain chains is longer than their known extent.* (The italics are mine.)

It seems to me that these and other parts of his lecture throw an interesting light on the theory of the moon's terrestrial origin. In brief, the theory is that when the earth had cooled from its molten condition sufficiently to have a crust of solidified matter something like thirty miles thick over its entire surface, it was revolving so rapidly that gravitational attraction and centrifugal force practically balanced each other. For some reason, perhaps some vast and sudden cataclysm, a large portion of this crust was thrown off the earth, and by tidal action was forced gradually outward in a spiral path. In order to form the moon, a mass of this crust about thirty miles thick and of area nearly equal to the combined areas of the present oceans on the earth must have been thrown off. It is supposed that this immense amount of crust was largely taken from the present basin of the Pacific, and that the remaining parts of the earth's crust, while it still floated on a liquid interior, split along an irregular line into two pieces which floated apart, and the gap between these two parts was later filled with the waters of the Atlantic. Many reasons are advanced for the probability of this theory—the fact that the two coasts of the Atlantic have the same contour, the identity between the density of the moon and that of the earth-crust, etc. Professor Penck is evidently not considering this theory at all in his lecture, and yet it seems that what he, approaching the problem from a geographical standpoint, has to say about it, lends a greater probability to the theory. As he says, the Appalachian region ends at Newfoundland, about the latitude of 50° north, and just opposite, in Great Britain, on the same latitude, the same region seems to continue. If the theory of the terrestrial origin of the moon, outlined above, be accepted, we can explain this phenomenon much more simply than did Bertrand, and need not suppose the range to extend across the bed of the Atlantic at all.

ANDREW H. PATTERSON
UNIVERSITY OF NORTH CAROLINA

SCIENTIFIC BOOKS

Scientific Ideas of To-day. A popular account of the nature of matter, electricity, light, heat, etc., in non-technical language. By CHARLES R. GIBSON. Pp. 344; illustrated. Philadelphia, J. B. Lippincott Company. 1909.

This book is one which would justify a favorable estimate from almost any other point of view than that which the present reviewer chooses to take. Thus, William E. Rolston gives a favorable estimate of the book in his review of it in *Nature;* indeed many sections of the book are such as to demand a favorable estimate from any point of view. For example, the description in terms of the electron theory of what takes place when glass is rubbed with silk or when zinc is dissolved in a voltaic cell (see pages 73–79) is as clear as any one could wish to have it; and in many cases the "scientific ideas of to-day" which are elaborated in the book are applied at once to the analysis of actual phenomena. But some weeks after looking over the book, I came upon what to me seems to be a very significant paper by Professor William James, "On a

Very Prevalent Abuse of Abstraction,"[1] which happens to express precisely what I wish to say concerning the book and the kind of popular scientific writing which it represents. Professor James says that "to be helped to anticipate consequences is always a gain, and such being the help that abstract concepts give us, it is obvious that their use is fulfilled only when we get back again into concrete particulars by their means." By far the greater portion of the book under review fails to meet this condition of utility, and on the whole the book can not be looked upon as a preliminary step towards a subsequent realization of this idea of utility.

One phase of the author's point of view may be seen in the following quotations: "Water is nothing more or less than a chemical combination of two gases" (page 25); "Chemical affinity is nothing more or less than electrical attraction between different atoms" (page 29); "An electron is nothing more or less than electric charge in motion" (page 51); "An electric current is nothing more or less than an electron current" (page 75); "Light is simply waves in the ether" (page 153); "It must be clearly understood that all atoms of matter are made up of a number of electrons revolving in regular orbits, and that we can not in any way disturb these arrangements" (page 157). As if one could be placed under obligations to clearly understand any physical fact in terms of an extremely vague hypothesis!

Professor James gives the name "vicious abstractionism" to this mode of using concepts. He says:

> We can see a concrete situation by singling out some salient or important feature in it, and classifying it under that; then, instead of adding to its previous characters all the positive consequences which the new way of conceiving it may bring, we proceed to use our concept privatively; we reduce the originally rich phenomenon to the naked suggestions of that name abstractly taken, treating it as a case of "nothing but" that concept, and acting as if all the other characters from out of which the concept is abstracted were expunged. Abstraction functioning in this way becomes a means of arrest far more than a means of advance in thought.

[1] *Popular Science Monthly*, May, 1909.

The viciously privative employment of abstract characters seems to be the greatest infirmity of the average mind in scientific work, and books like this of Mr. Gibson's stand for the extension to a wide circle of readers of a hopelessly sterile philosophical by-product of the modern physical sciences.

The authors of such books as "Scientific Ideas of To-day" stand before us, indeed, chiefly in the rôle of teachers; but the teaching of the physical sciences is to a very great extent a matter of exacting constraint, and it can not be accomplished in a manner which is pleasant and popular.

> Da wird der Geist Euch wohl dressiert
> In spanische Stiefeln eingeschnürt.

The teaching of physical sciences is indeed a compelling insistence upon precise ideas, a forcible "making up" of a student's mind, as it were; for, as Whewell says, nothing is so essential in the acquirement of exact and solid knowledge as the possession of precise ideas, not, indeed, that a perfect precision is necessary as a means of retaining knowledge, but that nothing else so effectually opens the mind for the perception even of the simplest evidences of a subject.

In speaking of the constraint that is involved in genuine science teaching I do not refer to the necessity of overcoming indifference, but to a condition which is real in the face of any amount and any quality of enthusiasm. Every one is of course familiar with the life history of a butterfly, how it lives first as a caterpillar and then undergoes a complete transformation into a winged insect. It is of course evident that the bodily organs of the caterpillar are not at all suited to the needs of a butterfly, the very food (of those species which take food) being entirely different. As a matter of fact, almost every portion of the bodily structure of the butterfly is dissolved into a formless pulp at the beginning of the transformation, and the organization of a flying insect then grows out from a central nucleus very much as a chicken grows in the food-stuff of an egg. So it is in the development of a scientifically trained mind. In early

childhood, if the individual has been favored by fortune, he exercises and develops more or less extensively the primitive instincts and modes of the race in a free out-door life, and the result is so much mind-stuff to be dissolved and transformed with more or less coercion and under more or less constraint into a mind of the twentieth-century type. The period during which a young man is receiving his scientific and professional training is indeed analogous in many respects to the period of complete reorganization of bodily structure, and in the other we have a reorganization no less complete of mental structure; in the one the reorganization is wholly dependent upon and determined by internal energies, but in the other the reorganization is largely dependent upon and determined by external constraint.

It is a remarkable thing this changing of men into bees and butterflies! and the operation is indeed severe. But perhaps the most remarkable thing about it is that it is elective in particular, but apparently in our day a dire necessity in general, somewhat like the curious transformation of the axolotl, which lives always and reproduces his kind as a tadpole unless a stress of dry weather annihilates his watery world when he lops off his tasseled gills, develops a pair of lungs and embarks on a new mode of life on land.

A severe operation! And usually for the individual a change, like that of the axolotl, from a fluid world to a rigid one! I remember as a boy a sharp contest in my own mind between an extremely vivid sense of things physical and the constraining function of precise ideas. This contest is perennial, but it is not by any means a one-sided contest between mere crudity and refinement, for refinement ignores many things. Indeed precise ideas not only help to form our sense of the world in which we live, but they tend to inhibit sense as well, and a world in which their rule is unchallenged becomes indeed a dry and rigid world.

Every student should realize two things in connection with his science study; the first is that the study of the physical sciences is exacting beyond all compromise, involving as it does a degree of coercion and constraint which it is beyond the power of any teacher greatly to mitigate; and the second is that the completest science stands abashed before the infinitely complicated and fluid array of phenomena of the material world, except only in the assurance which its method gives. And both of these things are obscured by books like "Scientific Ideas of To-day," books that know nothing of exacting constraint nor ever stand abashed. The attempt to set forth in an easily plausible style the conceptual structure of modern physical science is one of the most troublesome perversions with which one has to deal in the attempt to contribute towards the solution of what is to be perhaps the greatest problem of the twentieth century, namely, the making available to all men of the simpler phases of the logical structure of the sciences in order to give to all men some measure of that clear insight into nature which contributes so greatly to the ordering of one's daily life.

W. S. FRANKLIN

LEHIGH UNIVERSITY

Normentafel zur Entwicklungsgeschichte des Menschen. By FRANZ KEIBEL and CURT ELZE. 4to, 314 pp., 6 pls., and numerous text figs. Jena, Gustav Fischer. 1908.

This eighth volume in Professor Keibel's series of "Normentafeln" is much larger than any of its predecessors, thus reflecting the special interest which mankind takes in human embryology. Like the earlier numbers it consists essentially of a tabular description of embryos, with plates showing their external form, and a classified bibliography. The titles of papers relating to human embryology occupy 150 quarto pages, and yet, of the publications dealing with malformations, only the more comprehensive have been included. The bibliography is so thorough and useful that it renders this "Normentafel" indispensable to every student of vertebrate embryology. The plates are excellent, and show embryos from 1.17 to 24 mm. in length, seen in several positions. The text figures include numerous single sections, and several partial reconstructions of the embryos described. A

complete series of graphic reconstructions would seem to justify the great amount of labor which it requires, and, at the reviewer's suggestion, Mr. R. E. Scammon is preparing such a series for the "Normentafel" of *Squalus acanthias*. In the Harvard Laboratory some progress has been made toward such a series for the pig. This plan has been partly carried out in the "Normentafel" for man, thus adding materially to its value. The text figures accompany the brief descriptions of the various embryos, which precede the tables.

In addition to the descriptions, tables, plates and bibliography, there are three general discussions of great interest. The first (pp. 7–14) is a critical account of the youngest known human embryos. There has been something hardly scientific in the attempt to obtain the "youngest yet known"—in the description of specimens "excessivement jeune," and in monographs on fragments and pathological debris. Keibel's review shows that the two pages written by von Spee, included in Peters's monograph of 143 pages dealing with a single specimen, is at present the most illuminating account of the youngest human embryo. A reconstruction of this specimen, made by Keibel, is described briefly. From the study of Peters's, von Spee's and Keibel's youngest specimens it is inferred that the cavities of the human amnion, yolk-sac and extra-embryonic cœlom arise as clefts in solid masses of cells; their development is illustrated in a series of diagrams. An amniotic duct, such as is indicated in Eternod's familiar model, is not found in the younger specimens, and in these there is no neurenteric canal.

The second general chapter (pp. 80–89) includes a comparison of human embryos with those of apes and *Tarsius*. It is found that the youngest stages of man and the apes are very similar, but that they differ materially from *Tarsius* at a corresponding stage. Although the human embryo is very much like that of an orang, "a glance is sufficient to distinguish it from any other well-known form." In this chapter it is stated that the bend in the back of human embryos, such as is seen in the reproductions of the His models found in most laboratories, is abnormal.

The third section (pp. 152–162) is a comparative embryological study of various structures, based upon the preceding numbers of the "Normentafeln." Thus it is stated that the allantois in man and the apes develops very early, before segments have formed. In *Tarsius* also it arises before there are any segments, but later than in man and the apes. It first appears in pigs of four to five pairs of segments, in rabbits of about eleven pairs and in chicks of more than twenty pairs. Similar comparisons are made for the lungs, pancreas, thyreoid gland, etc. A foundation is thus laid for future work in comparative embryology which shall be more accurate and detailed than anything yet realized.

It may be noted that in two human specimens, a fifth pair of pharyngeal pouches was identified, in one case reaching the ectoderm. Fox's recent studies of the pig, cat and rabbit have failed to show a fifth pouch, but Tandler declares that its presence in man is not a morphological speculation—it is an established fact. This question is clearly one which requires further study. In fact the great value of this "Normentafel" is the stimulus and aid which it affords to further research. The need of early human embryos is emphasized. The omission of any account of the muscular and lymphatic systems is conspicuous. But the great progress which has been recently made in human embryology has been compactly recorded. The work is of the utmost practical value, and in a recent discriminating review it has been described as a "masterpiece of scientific effort." It is the only comprehensive account of strictly human embryology which is now available.

Frederic T. Lewis

SPECIAL ARTICLES

NOTICE OF TWO NEW HORIZONS FOR MARINE FOSSILS IN WESTERN PENNSYLVANIA

Since the time of the second geological survey of Pennsylvania it has been generally accepted that there are three horizons at which marine fossils may be found in the Conemaugh series of western Pennsylvania. The oldest of these is the Brush Creek limestone, about

100 to 125 feet above the Upper Freeport coal. From 60 to 90 feet above this is the Pine Creek limestone, while the Ames limestone is about 125 feet above the Pine Creek and 300 feet below the Pittsburg coal. Under various names these limestones have been reported from a large area in western Pennsylvania, northern West Virginia and southeastern Ohio. As these limestones are all very thin and are included in a great mass of shales and sandstones of debatable origin, the discovery of two more layers containing marine fossils is of some interest.

The first of the layers is about 50 feet below the base of the Ames limestone on Brighton Road, just west of Wood's Run, Allegheny, Pa. This stratum was noted by the writer in 1907, but as it was found in only one place, it was thought at the time that it might be a disturbed block of the Ames limestone. It was, however, mentioned in a paper just published in the *Annals of the Carnegie Museum,* Volume V., page 174, and its correct stratigraphic position indicated in the diagram on Plate XII. As exposed at the type-locality on Brighton Road, the fossiliferous layer is about three inches thick and contains numerous crinoid stems, *Producti,* and cup-corals. It is a hard clayey limestone, with most of the lime leached out at the outcrop. It outcrops at a number of places within two miles of this locality, but has not yet been traced to any distance. At some of the other outcrops the layer is thicker, the greatest thickness noted being eighteen inches.

In an article on the Conemaugh formation in southern Ohio just published in the *Ohio Naturalist,* Mr. D. Dale Condit describes a thin marine limestone about half-way between the Ames and the Upper Cambridge limestones. This limestone occupies the same stratigraphic position as the one here described, but as they are separated by a very wide area in which neither has been sought, it is too early to attempt to correlate the two.

The credit for the discovery of the second layer with marine fossils belongs largely to the Rev. P. E. Nordgren, of Duquesne, Pa., who found loose blocks of fossiliferous shale along the railroad tracks about two miles west of Duquesne. The writer was able to trace these blocks to their source in a layer of green sandy shale at the top of the Birmingham shale. This layer is about 65 feet above the Ames limestone. In the vicinity of Pittsburg the Birmingham shale is a conspicuous formation in the cliffs which border the rivers. It is from 40 to 50 feet in thickness and the base is about 25 feet above the top of the Ames. At the base of the Birmingham there is always a layer of very thin-bedded black shale, and sometimes a coal which is supposed to represent the Elk Lick. Above this carbonaceous layer are thin-bedded dark shales which contain pinnules and stems of ferns, and numerous *Estherias* and fish-scales. Higher up the shales become lighter colored, often sandy, and are very barren of fossils. The only fossils so far found in these light-colored layers are a few specimens of an *Aviculopecten* like *A. whitei,* a shell which is often found associated with fossil plants. At the top of the Birmingham there is an abrupt change in the color, the upper 8 to 15 feet being a red fissile shale. Just beneath the red shale, or sometimes a few feet above the base of the shale, there is a rather prominent layer of sandy shale which has now been found to contain marine fossils. The fossils are species of *Productus, Allorisma* and other pelecypods, and *Tainoceras occidentale.* Fossils have been found in this layer in Riverview Park, Allegheny, below Kennywood Park near Duquesne, at Glassport, at Wilmerding and at East Pittsburg. It is most fossiliferous at the locality discovered by Mr. Nordgren below Kennywood Park, and that should be considered as the type-locality.

In Riverview Park *Aviculopecten* may be found in a layer 25 feet above the layer just described and a further search for fossils may show that the Ames is far from being the last marine deposit in western Pennsylvania.

PERCY E. RAYMOND

CARNEGIE MUSEUM,
May 7, 1909

NEW FACTS ABOUT BACTERIA OF CALIFORNIA SOILS

THE bacteriological study of California soils at this Experiment Station during the past year

marks the beginning of research on the biology of soils of the arid regions. Some of the facts gleaned in these studies present such striking features that it was thought wise to make a brief preliminary report on them in this journal. The facts may be categorically enumerated as follows:

1. Nitrite formation from ammonia compounds formed by the ammonifying bacteria has been found to take place markedly at depths of twelve feet in a soil from Haywards, Cal. Further, in samples gathered under the greatest precautious to avoid contamination, nitrite formation was found to go on actively at a depth of five and one half feet in a soil gathered at Riverside, Cal. Below five and one half feet there was a compact layer of hardpan in which there was little or no bacterial growth and nitrite formation could not, therefore, be expected deeper down in that particular soil. In six other soils collected in different parts of this state nitrite formation was found to depths of six feet or as far down as we had gone for samples.

2. Contrary to expectations *nitrate* formation, unlike nitrite formation, has thus far been noted only down to a depth of two feet. Further experiments, however, will be instituted to ascertain if this holds true for all California soils.

3. A bacteriological examination of a soil from Auburn, kept in a tightly stoppered bottle on the museum shelves for thirty-one years, reveals at least one representative of each of the groups of nitrogen-transforming or nitrogen-assimilating bacteria, except *B. radicicola*. Of these, several species of ammonifiers were found, one species of nitrosomonas (obtained in the motile and also in the zooglœa form) and one spiecies of *Azotobacter*. The latter exhibits marked differences from the other *Azotobacter* species thus far described, both morphologically and physiologically, and it was therefore named *A. hilgardii* in appreciation of the eminent services of Professor E. W. Hilgard to scientific agriculture. Briefly, the organism may be described as a small elliptical cell, which forms no pigment and only a very thin membrane at the surface of mannite solutions. It is non-motile and has a slight nitrogen-fixing power.

4. The species of nitrosomonas found in the old soil mentioned above was found to have spores. This is particularly interesting, since Winogradsky stated in a report of results of his wonderfully thorough experiments on the nitrifiers, that spores were *never* observed.

No *Nitrobacter* species or nitrate organism has as yet been found in the old soil.

The above facts are probably due chiefly to the great perviousness of the soils of the arid region, owing to the very slow formation of clay substances; whereby moisture, air and roots are enabled to penetrate to depths rarely found in the humid regions.

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UNIVERSITY OF CALIFORNIA,
May 12, 1909

A SCHEME TO REPRESENT TYPE HEREDITY IN MAN

EFFORTS to reconcile Mendel's laws with the prevailing views of blended effects in heredity need not be unavailing, if the two may be considered as phases of the same process acting at different times during the life history of an elementary species.[1]

Heredity represents all the changes of organic life by three factors:

1. *Determinants,* which are in the germ plasm.

2. *Modifiers,* which are all influences through time and space that act on the germ plasm, and

3. *Laws of change,* which are the rules of conduct by which the determinants and the modifiers interact.

These factors are variable when looked at through all space and during all time, but for any elementary species in a given space and for a limited time they are fixed.

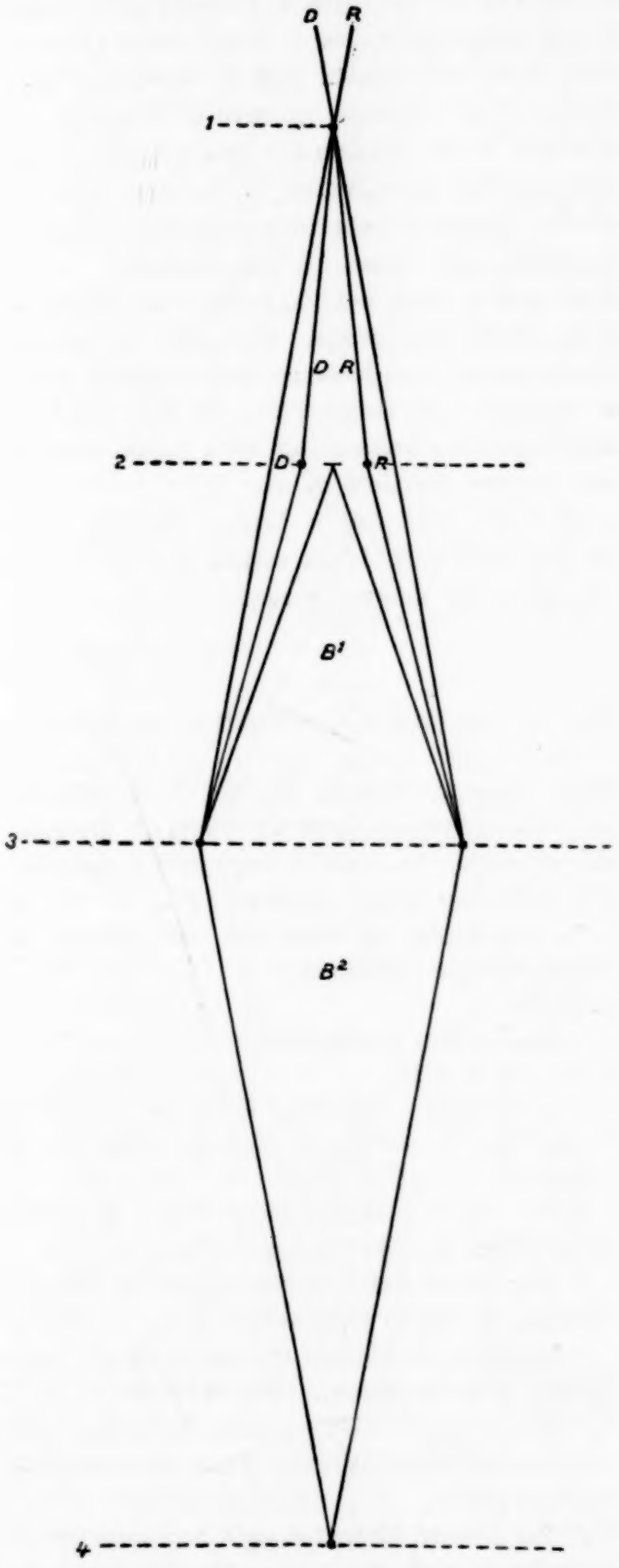
I present herewith a tentative scheme to supplement my theory of heredity.[2]

D and *R* represent homozygotes of an

[1] Spillman, SCIENCE, N. S., Vol. XXVII., 1908, pp. 47–57.

[2] Bean, *Philippine Journal of Science*, 1908.

allelomorphic pair that meet at 1 in sexual union, begin to blend at 2, present the picture of a variable blend at 3, and fuse completely



into a perfect blend at 4. A cross-section of the diagram above line 3 represents the relative number of individuals of the different kinds present at that time. The width of the diagram also indicates the amount of variation at any time. $D =$ homozygous dominants. $R =$ homozygous recessives. $DR =$ heterozygotes. $B^1 =$ a variable blend ever increasing in number with each successive generation while D, R and DR decrease to disappear entirely at 3. B^2 represents the continuation of the blend without either of the originals of the allelomorphic pair, but with all shades of intervening characters blending in various ways as influenced by ancestry and by environment, until a homozygote is formed at 4.

From 1 to 2 true Mendelism exists, spurious Mendelism is found from 2 to 3, and from 3 to 4 no Mendelism is present but two tendencies prevail, (*a*) the reversion to type, and (*b*) the tendency to blend.

The three Mendelian (?) conditions may exist at the same time in a single individual, one character exhibiting true Mendelism, another false and a third no Mendelism, or only one condition may be present at one time.

Davenport and Davenport[3] have established true Mendelian heredity for eye color in man; Bateson[4] has designated many conditions in man which indicate spurious Mendelism; and Boas[5] has suggested the two hereditary tendencies above mentioned, when broad-headed and long-headed, or wide-faced and long-faced individuals are united in marriage.

My records of Negroes, of white students, and of the Filipinos suggest that composite types (elementary species?) of men when crossed with opposite types follow the laws of Mendel for not many generations, then begin to blend, and eventually fulfill the requirements of my scheme delineated above. At present all mixed races are probably in a condition of spurious Mendelism or no Mendelism. Among the Negroes in America the Hottentot is rarely seen, the Kaffir is often encountered, and the Guinea Coast Negro is abundant, but the majority of the Negro population represents a variable blend of different Negro types, and a large number of mixed

[3] Science, N. S., Vol. XXVI., 1908, p. 589.

[4] *Brain*, 1906.

[5] *American Anthropologist*, 1903, 1907.

bloods. Among 1,000 students at Ann Arbor, I observed a few of each of the types of Europe such as the Iberian, Northern, Alpine, Celt, Littoral and Adriatic, but the majority of the students observed were variable blends, and the pure types were not exactly like the prehistoric types of Europe from which they were probably derived, although similar to them in many ways. During the past year my anthropometric investigations have included the Filipinos of many provinces, but especially the Igorots. Here as elsewhere pure types are rare and blends are plentiful. Three primary types (each represented by 8 or 9 individuals selected from 104 Igorots) are found among the Igorots. None of these are pure, however, but one type resembles the Negrito, another resembles one of the prehistoric types of Europe, while the third is unlike either of the others, but not a blend of the two. The majority of the Igorots represent a variable blend, and they have been so long isolated that a condition of no Mendelism has been reached. There is conclusive evidence of the persistence of type, yet the tendency to blend is emphatic.

Robert Bennett Bean
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Manila, P. I.

A NEW EDIBLE SPECIES OF AMANITA

During the autumn of 1908 I received specimens and sketches of an interesting species of *Amanita* which grows in the mountain forests of California. The specimens were collected and communicated by Mrs. Virginia Garland Ballen, of Brookdale, Santa Cruz County, Cal. The sketches were accompanied by careful notes which Mrs. Ballen had made from her studies and observations. While the plant shows certain points of relationship to *Amanita cæsarea,* especially to the robust European form, Mrs. Ballen had recognized that it was different from the American form of *A. cæsarea,* which is more slender, and in fact it proves to differ in several ways from that species. The plant is edible and often very large, so that a single one is sufficient for a meal. Pending a fuller illustrated account, a brief description is given here.

Amanita calyptroderma Atkinson and Ballen n. sp. Plants 10–15 cm. high, pileus 10–22 cm. broad, stem 2–4 cm. stout. Pileus maize yellow to chrome yellow; gills white, then pale maize yellow to cream color; annulus and stem pale maize yellow to cream color. Pileus stout, extreme margin striate, the central and larger portion covered with the closely adherent white calyptra of the volva; in age of the larger plants this calyptra sometimes cracking into areas. Gills adnexed. Spores oval to elliptical, $8–12 \times 7–8\,\mu$. Annulus very thin, membranaceous, superior, evanescent. Stem hollow with loose cottony threads. Volva white, thick, circumscissile, in dehiscence, the upper portion remaining as a thick skin over the central portion of the pileus; limb very prominent, forming a broad cup- or saucer-shaped structure from which the stem of old plants often separates readily.

Geo. F. Atkinson

THE AMERICAN ASSOCIATION OF MUSEUMS

The fourth annual meeting of the American Association of Museums was held in Philadelphia, May 11–13, President W. J. Holland, director of the Carnegie Museum in Pittsburgh, presiding. The following papers were read:

"Cooperation in Scientific and Educational Work between Museums," by President William J. Holland.

"Cooperation among College Museums," by Dr. Daniel S. Martin.

"Cooperation between Museums in Expert Work," by Dr. Edwin A. Barber. (Read by title only.)

"The New Staten Island Museum and its Work," by Mr. Charles Louis Pollard.

"The Insect Pests of Museums," by Mr. C. T. Brues. (Read by title only.)

"Invertebrate Models and Exhibition Groups," by Mr. Roy W. Miner. (Illustrated.)

"The Children's Museum, its Methods of Work and its Results," by Miss Anna Billings Gallup. (Illustrated.)

"The Use of Unkerheimer's Solution for Preservation of Natural Foliage," by Mr. Adolphe B. Covert. (Illustrated.)

"The Darwin Exhibit at the American Museum of Natural History," by Mr. Roy W. Miner. (Read by title only.)

"The British Guiana Expedition of Indiana University and the Carnegie Museum," by Dr. C. H. Eigenmann. (Illustrated.)

"A New Museum Case," by Dr. Hermon C. Bumpus.

"The Educational Work of the Buffalo Society of Natural Sciences," by Mr. Henry R. Howland.

"Suggestions for an Educational Exhibit of the Mollusca," by Mr. Frank C. Baker.

"Present Educational Work of the Philadelphia Museums," by Mr. Chas. R. Toothaker.

"What shall we do with our Skeletons and our Fossils?" by Mr. Henry L. Ward. (Read by title only.)

"The History of Commerce in Museums," by Mr. W. H. Schoff.

"Photographic Enlarging Methods," by Mr. Fred. D. Maisch.

"The Adaptation of a Library to a Commercial and Economic Museum," by Mr. John J. Macfarlane.

"Some of the Most Recent Museum Instruments and Appliances," by Dr. M. J. Greenman.

"The Planning and Fitting of Exhibition Rooms, Especially Picture Galleries," by Mr. Wm. M. R. French.

"Art Museums and the Conservation of Monuments," by Mr. Benjamin Ives Gilman.

"The Desirable Projection of Art Museums as suggested by the Desirable Classification of Art Libraries," by Mr. William H. Goodyear.

"The Training of Curators," by Mrs. Cornelius Stevenson.

"Problems of Modernizing an Old Museum," by Mr. Witmer Stone.

"Exhibition Cases without Shelves," by Mr. Frank C. Baker.

"A Device for exhibiting Fadable Minerals," by Dr. Oliver C. Farrington.

"The Uses of a Collection of Historical Coins," by Dr. T. L. Comparette.

"Popular *versus* Scientific Arrangement of Museum Exhibits," by Dr. James E. Talmage.

"Special Work of a State Museum," by Dr. A. R. Crook.

"Progress of the Ohio Archeological Atlas," by Professor William C. Mills.

These papers will appear in full in the annual volume of proceedings, to be published by the secretary during the summer.

The following officers were elected by the association:

President—Frederic A. Lucas, curator-in-chief of the Museums of the Brooklyn Institute of Arts and Sciences.

First Vice-president—Frederick J. V. Skiff, director of the Field Museum of Natural History, Chicago.

Second Vice-president—Edward S. Morse, director of the Peabody Museum, Salem, Mass.

Secretary—Paul M. Rea, director of the Charleston Museum, Charleston, S. C.

Treasurer—William P. Wilson, director of the Philadelphia Museums, Philadelphia.

Councilors (to serve for three years)—James E. Talmage, director of the Deseret Museum, Salt Lake City, Utah; William J. Holland, director of the Carnegie Museum, Pittsburgh.

The fifth annual meeting will be held in Buffalo in 1910.

The association is preparing "A Directory of Museums of Art, History and Science in North and South America," and all museums which have not received circulars requesting information for incorporation in this work are urged to communicate at once with the secretary.

PAUL M. REA,
Secretary

THE CHARLESTON MUSEUM,
CHARLESTON, S. C.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 215th meeting of the society, held at the Cosmos Club, on Wednesday evening, February 24, 1909, Mr. David White presented an informal communication on the "Occurrence of Resin in Paleozoic Coals," and exhibited specimens of such fossil resins from the Coal Measures of Iowa, Illinois and Indiana. Amber and other fossil resins occur mostly in Mesozoic and Tertiary coals that have not been much altered, but in coals that have suffered regional metamorphism they are as a rule absent. Where devolatilization has advanced so far that the percentage of fixed carbon is 65 or more they are seldom found.

Regular Program

Correlation of the Rocks of the Boston Region: LAURENCE LAFORGE.

After a brief résumé of the development of the current ideas on the subject, the following outline grouping of the various rocks was described.

There are two series of sediments, Cambrian and Carboniferous. For the fossiliferous beds of lower Cambrian age the name Weymouth formation has been proposed, while the Braintree slate contains a

middle Cambrian fauna, and there is a non-fossiliferous group of quartzites, schists and hornfels, which may be of any age from lower Cambrian to Ordovician. The Carboniferous sediments comprise the so-called Roxbury conglomerate and Cambridge slate.

About forty varieties of igneous rocks are separated into the following groups on the basis of consanguinity, association and structural relations: (1) a "gabbroic" group, including gabbro, basalt, diorite, amphibolite, etc., of presumably Ordovician age, and represented in the diorite complex of Swampscott, etc.; (2) a "tonalitic" group, comprising granite, tonalite and diorite, probably post-Ordovician and pre-Carboniferous, and represented by the granites of Saugus and Dedham, etc.; (3) a "felsitic" group, a complex of felsites, granophyres, tuffs and breccias, of early Carboniferous age, and covering several large areas; (4) a "granitic" group, including granite, quartz porphyry, nordmarkite, etc., represented by the granites of Quincy and Peabody, etc., of Carboniferous age and possibly contemporaneous with the "felsitic" group; (5) a "basaltic" group, represented by the "Brighton amygdaloid," of Carboniferous age, and (6) a "diabasic" group, comprising hundreds of dikes of Triassic age. There are also some pre-Triassic diabases, of as yet uncertain age.

Fluidal Gneiss and Contemporary Pegmatites: WHITMAN CROSS.

In the Needles Mountain pre-Cambrian area in southwestern Colorado there are several granitic batholiths. One of these, called the Twilight granite mass, is intruded in most intricate fashion in steeply upturned Archean amphibole schists.

Both gneissic and schistose textures are exhibited in the intrusive granite. The former is a fluidal texture originating during the consolidation of the granite. Such textures curve in and out among amphibole schist fragments, the sharp angles of which are notable. Where a secondary schistose texture occurs the amphibole schist and granite are both crushed and sheared and it is difficult to determine in certain localities which is the intrusive rock.

Pegmatite occurs as a phase of the granite in arms penetrating amphibole schist or in relatively small dikes connecting larger gneissose bodies. The transition of the pegmatite into gneissoid granite or granular rock and the absence of pegmatitic dikes cutting the latter show that the pegmatite is practically contemporaneous with the granite. None of these pegmatite masses is more than a few inches wide and the minerals are those of the biotite granite.

Pleistocene Geology of the Leadville Quadrangle, Colorado: S. R. CAPPS.

The work was commenced in 1903 with E. K. Leffingwell, and completed the following summer with the assistance of J. M. Hill and C. A. Kirtley. Of the 950 square miles of the quadrangle, more than 350 square miles have been glaciated. In this area 36 ancient valley glaciers were studied and mapped. Moraines of two distinct epochs of glaciation, one much older than the other, were found. The ice of the earlier epoch covered approximately the same areas as that of the later one.

The great terraces near Leadville, which have hitherto been referred to as lake beds, are probably remnants of compound alluvial fans, deposited as outwash from the older glaciers. This conclusion is based upon the imperfect stratification of the materials, their lack of lake bed structures, the absence of shore lines, and upon the similarity in structure to present alluvial fans. The terraces also show the same amount of weathering as the older moraines, and the topographic relation between the terraces and these moraines is significant. Lower terraces were found which bear similar relations to the moraines left by the last glaciers. The courses of the Eagle River above Redcliff, and of the Arkansas River, near Granite, have been altered as the result of obstruction by the glaciers.

FRANCOIS E. MATTHES,
Secretary

AT the 216th meeting of the society, held at the Cosmos Club on Wednesday evening, March 10, 1909, Mr. Wirt Tassin presented an informal communication on "A Method of Illumination for the Study of Opaque Substances under the Microscope," and showed the apparatus for same in operation.

Mr. F. E. Matthes, on behalf of Mr. R. H. Chapman, gave a brief communication on the Culinan diamond, and showed glass models of the stone in the rough and of some of the larger gems cut from it.

Regular Program

Primary Scapolite in Igneous Rocks: F. C. CALKINS.

In the Philipsburg quadrangle, in western Montana, a thick series of sediments, largely calcareous, is invaded by batholiths of rocks allied

to quartz monzonite. Associated with some of these batholiths as marginal facies, as small stock-like masses, and as dikes cutting both igneous and sedimentary rocks, are rocks of aplitic habit characterized by the presence of lime-soda feldspar usually in excess of alkali feldspar, a diopsidic pyroxene, and abundant titanite. Some contain scapolite; in one instance this mineral formed about 20 per cent. of the rock. In this rock the scapolite encloses all the other minerals and interpenetrates with all but quartz and the minor accessories, so that there is no doubt of its primary character. Chemical analyses of two of the scapolite-bearing rocks show the remarkable combination of rather high SiO_2, low MgO and iron oxides, with high CaO and Na_2O; chlorine is more abundant than in most rocks. It is surmised that these unusual rocks have been formed by the solution of limestone in magmas of aplitic composition containing abundant chlorine. No partial stages of the assimilation have been observed, and it probably took place at great depths.

On the Origin of Peat: CHARLES A. DAVIS.

Peat deposits are formed: (1) in depressions below the ground water level, (2) on poorly drained land areas where the ground water level is near but usually below the surface. Deposits on slopes in regions of high atmospheric humidity and on subsiding coasts are included in (2).

In (1) the peat is formed mainly from aquatic plants, including microscopic algæ, the true aquatic higher plants, and a little drift material from the shores. As the peat approaches the water surface, amphibious plants, particularly sedges, other herbs and shrubs, grow out over it from the shore, and form a partly or wholly floating mat, which, later, is invaded by terrestrial plants, including sedges, grasses, ferns, shrubs, sphagnum moss and trees, in the order given. The time when each type appears depends on the height of the surface of the mat above the average water level. Peat formation may go on until the basin is filled, or its surface covered.

In (2) the plants forming the peat are mainly terrestrial, but the types chiefly contributing are controlled by the average height of the ground water level, and climatic conditions. If the ground water level rises with the peat, the entire deposit may be homogeneous, and formed by the same kind of plants; if it remains fixed, the bed is generally thin and varies from bottom to top; if the water rises periodically, the deposit is heterogeneous, with beds of the same structure repeated at intervals.

Decomposition of vegetable matter into peat is principally due to the activities of organisms, the most important being aerobic, hence the top strata of wet peat beds are usually most thoroughly decomposed.

The Landslide at Frank, Alberta: L. D. BURLING.

At 4:10 A.M., April 29, 1903, an amount of rock variously estimated at from 60,000,000 to 100,000,000 tons dropped away from the northeast face of Turtle Mountain, fell through a maximum vertical distance of 3,500 feet, and covered over a square mile of the valley bottom to an average depth of thirty to fifty feet. The slide wiped out the tipple work and buildings of a coal mine at the foot of the mountain, demolished eight houses and a number of smaller shacks and tents, destroyed about two miles of railroad track and killed about seventy people.

Turtle Mountain is an isolated mass situated just south of the Canadian Pacific Railway east of the Continental Divide between British Columbia and Alberta, and towers 3,000 feet above the town of Frank, which lies at its base. The upper part of the mountain is composed of massive upper Paleozoic limestones which dip westward at angles of 20 to 30 degrees. These limestones are thrust over nearly vertical shales and sandstones of Cretaceous age containing a workable coal seam twelve to sixteen feet thick. The strikes of the massive limestones, the thrust plane and the coal beds are very nearly parallel, and for a distance of three quarters of a mile (entirely across the face of the mountain) and for a vertical height of 300 to 400 feet, the entire coal bed had been either loosened or completely withdrawn.

The slide affected only the limestones above the thrust plane. The horizontal distance between the present crest of the mountain and the toe of the slide is nearly two miles, the maximum vertical difference 3,000 feet and the vertical distance between the crest and the toe 2,525 feet. The slope from the crest of the mountain to the lake at its foot is 32 degrees, the first thousand feet having a slope of about 65 degrees. From a width of 2,000 feet at the crest the talus has a width of nearly a mile at the lake, and with minor variations this width is continued to the hills opposite, a mile away.

Whatever may have been the immediate cause of the disaster—the period was one of frequent and marked alternate freeze and thaw, and seventeen men were at work in the coal mine at the time—cracks had been noticed on the back slope

of the former precipitous peak and the slide may have been brought about by some, if not most, of the following contributory causes: (1) the massive limestones forming the upper two thirds of the mountain had been thrust out over the underlying softer shales and sandstones, and therefore may have been in a state of more or less unstable equilibrium; (2) a considerable layer at the base of the massive limestones had been brecciated by the thrust faulting and had thus lost its homogeneity and competency; (3) the limestones forming the upper part of the mountain were very massive and thus more liable to accumulate strain and to give way in a body than would have been the case with weaker rocks; and (4) the opening up of so thick a coal seam, to such a height and for so long a distance in a direction perpendicular to the dip of the massive overlying beds, in rocks incompetent to withstand the pressure thus induced, created strains in the massive rocks from which the support had been removed.

PHILIP S. SMITH,
Secretary

AT the 217th meeting of the society, held at the Cosmos Club on Wednesday evening, March 24, 1909, under informal communications, Dr. J. W. Spencer presented briefly some notes on the "Recent Draining of Niagara Falls."

Regular Program

The Composition of Stony Meteorites: GEO. P. MERRILL.

The average of a large number of analyses of stony meteorites shows close agreement, after the elimination of the metallic iron, with terrestrial peridotites. From a magma of this kind no amount of magmatic differentiation could produce a series of rocks as rich in silica, alumina, lime and alkalies as those shown by the averages calculated by Clarke and Washington to be characteristic of the earth's crust. World origin through the segregation of materials of this nature is therefore impossible. At the same time it may be conceived that the relative proportion of the elements which make up the mineral matter in the various bodies wandering in remote space, varies widely. If this is so, the earth to-day, in its course, may be passing through and receiving from space deposits of material representing one and the same original body, but not necessarily resembling, in percentage composition, the materials which reached it during past and earlier stages of the earth's history. In brief, the stony meteorites may be regarded as products of an extremely basic phase of magmatic differentiation from a previously more acid magma.

Chemical Composition as a Criterion in Identifying Metamorphosed Sediments: E. S. BASTIN.

Chemical criteria need seldom be resorted to for the identification of metamorphosed sediments of a highly siliceous or a highly calcareous nature. They are inapplicable for the identification of many of the metamorphic equivalents of the arkoses, greywackes and similar rocks, since these may be almost identical in composition with the igneous rocks from which they have been derived. Chemical criteria are also inapplicable in the recognition of flow gneisses and of injection gneisses. Such criteria are therefore restricted in their usefulness for the most part to the differentiation of metamorphosed equivalents of the argillaceous sediments from metamorphosed plutonic and volcanic rocks.

The available analyses of metamorphosed igneous rocks show that well-developed foliated structures may in many cases be developed without important chemical changes, and it seems probable that in a very large number, if not in most, of the metamorphosed igneous rocks with which the geologist has to deal the chemical changes during metamorphism have not been severe enough to obscure their igneous characters. They are in many instances still igneous rocks in composition, and the chemical criteria for distinguishing them from metamorphosed sediments may be brought out by a comparison of the latter with normal igneous rocks as tabulated in Washington's tables of analyses.

The chemical characteristics of the argillaceous sediments and the changes they undergo during metamorphism may be determined by a comparison of the averages of a large number of analyses of clays, shales, slates and schists. By comparing these sedimentary averages with the igneous rocks as tabulated in Washington's tables of rock analyses, the following chemical characteristics are shown to be suggestive of sedimentary origin.

1. Excess of alumina (Al_2O_3) above the amount necessary to satisfy the ratio of 1 to 1 with which it is normally combined with lime and alkalies in igneous rocks.

2. Excess of magnesia over lime ($MgO > CaO$).

3. Excess of potash over soda ($K_2O > Na_2O$).

4. In some instances, excess of silica (SiO_2) has confirmatory critical value.

The evidence of sedimentary origin is greatly

strengthened when two or more of the relationships outlined above exist.

The general conclusion reached may be stated as follows: Both igneous and sedimentary rocks undergo chemical changes during dynamic metamorphism. Such changes in the sedimentary rocks are of considerable magnitude and their character is fairly well known. In the igneous rocks changes during dynamic metamorphism appear to be of much lesser magnitude and their character is not so well understood. The lesser degree of chemical alteration that they undergo as compared with the sediments makes it possible to distinguish between the two in many instances on chemical grounds.

Copper-bearing Amygdaloids of the White River Region, Alaska: ADOLPH KNOPF.

The copper-bearing rocks of the White River region, Alaska, comprise a stratiform succession of basaltic amygdaloids, porphyritic sheets, tuffs and breccias, several thousand feet thick, and constitute the dominant portion of a formation of Carboniferous age. In places the amygdaloids are highly zeolitic, and the zeolites form from 25 to 50 per cent. of the bulk of the rock. Native copper has been found intergrown with prehnite, calcite and zeolites filling the vacuoles in the ancient lavas. At some localities veinlets of chalcocite and laumontite cut the volcanics; at others there occur drusy veinlets consisting of quartz, chalcocite and a black combustible mineral, which when ignited burns with a smoky yellow flame. Veinlets of spherulitic prehnite intergrown with calcite and flecked with native copper and chalcocite, also traverse the amygdaloids. The association of a carbon mineral with cupriferous zeolitic amygdaloids appears to be a novel feature, and it is believed to afford a satisfactory explanation for the precipitation of the metallic copper from the mineral-bearing solutions.

FRANCOIS E. MATTHES,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 665th meeting was held in the afternoon of April 26, Vice-president Day in the chair.

At this meeting, which was complimentary to the American Physical Society, Professor Dr. Max Planck, of Berlin, addressed the society, by invitation, his subject being "Die Mechanik als Grundlage der Physik."

THE 666th meeting was held on May 8, 1909, Past-president Marvin in the chair. Two papers were read.

The Star List of the American Ephemeris: MILTON UPDEGRAFF, U. S. Naval Observatory.

Professor Updegraff gave an account of the star list of the "American Ephemeris" as contained in the first volume of that publication, which is for the year 1855, and also of the star lists contained in the five other national ephemerides of that date. He gave in detail the features of the star list of the "American Ephemeris" and "Nautical Almanac" as it will appear in the volume for the year 1912. The number of stars is to be 825: 800 ten-day stars, 15 northern circumpolar stars and 10 southern circumpolar stars; all circumpolars having their apparent places given for every day in the year. Provision will be made for convenient computation of the effect of the short terms of the nutation for each of the ephemerides of the ten-day stars. These short terms at their maxima and minima have an effect in declination of about a tenth of a second of arc, and in right ascension of nearly a hundredth of a second of time multiplied by the tangent of the declination, and are sufficiently large to make it necessary to take them into account in the more accurate kinds of astronomical work.

Attention was called to the fact that in the "American Ephemeris" the short terms have been included in the Besselian and independent star numbers since the volume for the year 1882, and this fact makes it desirable that the effect of these terms should also be allowed for in the ten-day ephemerides of the stars, although they can not be included directly, as the variation is so rapid as to render interpolation impossible.

A brief account was also given of the star lists contained in the issues for 1910 of the four other national ephemerides. Attention was called to the fact that in the new star list of the "American Ephemeris" the constants adopted by the Paris Conference of the directors of national ephemerides, held in 1896, have been used instead of the Struve-Peters constants which have hitherto been used in the "American Ephemeris," excepting the volume for the year 1900, in which the conference constants were used.

An account was also given of Professor Newcomb's suggested list of fundamental stars, which is now used as the basis of the star lists of all the national ephemerides excepting the *Berliner Jahrbuch.*

The Solar Parallax from Observations on the Planet Eros: C. W. FREDERICK, U. S. Naval Observatory.

The discovery of the planet Eros in 1898 gave astronomers an opportunity to make a more accurate determination of the solar parallax, as the new asteroid approached nearer the earth than any other heavenly body except the moon. Accordingly a campaign was planned for the winter of 1900–1, nearly fifty observatories taking part in the work of observing the planet. The reduction of the observations made at Washington has recently been completed, and the resulting value of the solar parallax is $\pi = 8''.808$ with a probable error of $\pm 0''.012$. This indicates a value greater than $8''.800$, which is contrary to the expectation of astronomers.

R. L. Faris,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The last regular meeting of the session of 1908–9 was held on May 14.

The following papers were read:

"The Synthesis of 1, 3, 7, 9 Naphthotetrazines," by A. H. Kroppf.

"Peptic Digestion in Aqueous Solutions of Pure Acid Salts," by R. A. Gortner and A. H. Kroppf.

"The Change in Refractive Index with Temperature," by K. Geo. Falk.

"Investigations on the Relative Value of Several Nitrogenous Materials as a Source of Nitrogen to Crops," E. B. Voorhees and J. G. Lipman.

"The Solubility of Salts in Concentrated Acids," by A. E. Hill and J. P. Simmons.

"Congo Blue—Is it a Free Base or a Salt? Congo White—an Aniline Salt of Congo Blue," by I. W. Fay.

"Soluble and Fusible Resinous Condensation Products of Formaldehyde and Phenol," by L. H. Baekeland.

The Rules for the award of the Nichols medal adopted by the New York Section, June 10, 1904, were amended to read as follows:

Rules for the Award of the Nichols Medal (adopted by the New York Section, June 10, 1904; amended, May 14, 1909).

1. A Nichols medal or medals shall be awarded annually for the best paper presented to the New York Section during the previous season, provided the paper is of sufficient merit. The award may be made to any one, whether a member of the society or not, if the paper is eligible under the following conditions:

(*a*) The paper must embody the results of original research in chemistry, which results shall not have been made public before their presentation to the New York Section.

(*b*) The paper must be presented at a stated meeting of the New York Section between the first day of October and the fifteenth day of June.

(*c*) The paper must be presented in its completed form, unless otherwise specially authorized by the executive committee.

(*d*) Within thirty days after being read before the New York Section, the completed manuscript shall be transmitted to the editor of that one of the society's journals for which the paper seems most appropriate.

2. The jury to determine the best paper among those eligible for the award under the above conditions, shall consist of the editors of the society's publications together with such of the associate editors as they may invite to act with them. The editor of the *Journal of the American Chemical Society* shall be the chairman of this jury. Should the jury thus authorized decline to serve, the executive committee of the New York Section shall designate another jury. The jury shall report their decision to the executive committee of the New York Section, who shall have power to decide whether the paper selected is worthy of the award.

3. The secretary of the New York Section shall send to the editor of the *Journal of the American Chemical Society*, as chairman of the above jury, on or before July 1 of every year, a list of the papers which are eligible under the above conditions, with the request that said jury report to the executive committee of the New York Section by the fifteenth of September next following.

4. In case the paper selected for the award is the work of more than one author, the executive committee may present a medal to every author, the names of all the authors being engraved on each medal.

5. The medal or medals shall be presented at the regular October meeting of the section, or as soon thereafter as may be possible.

6. The executive committee shall have power to decide any question not specifically covered by these rules.

7. Any motion to change or amend these rules must be submitted to the section in writing at least one month before being put to a vote, and notice of the proposed change must be made public at the same time and in the same manner as announcement of the meeting at which the motion is to be put.

C. M. Joyce,
Secretary